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■ Free Utility: Use Long File-Names in DOS

■ 9 Web Servers Put To the Test

◄ Pullout: How to Cut Your TCO

► First Looks: 9 Pentium II Notebooks with Power to Spare

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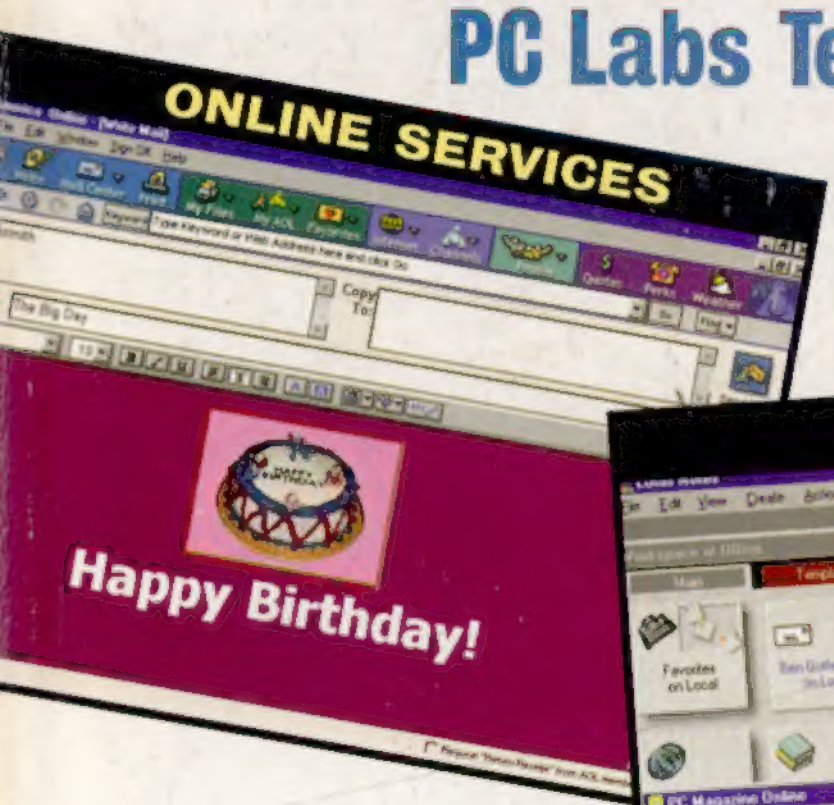

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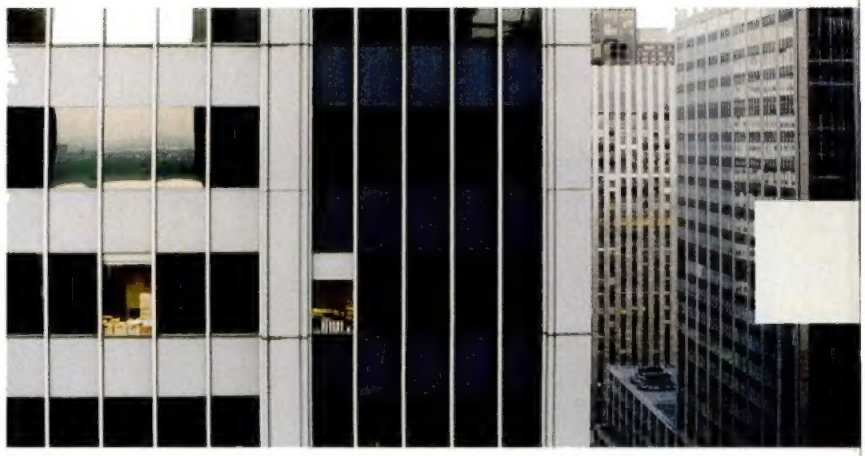

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A Modest Proposal

In my previous column, I concluded that the question isn't whether Microsoft should be regulated but *how*. I'm far from convinced that government regulation or intervention will improve things. But I am convinced, based on recent statements from the Justice Department, various state attorneys general, and the Senate Judiciary Committee, that this case is far from over.

Several choices are possible: Microsoft and the Justice Department could end up with another consent decree, Congress could attempt to pass new rules, or the pressure of pending litigation could force Microsoft to regulate itself to avoid new government rules, much the way IBM regulated itself during its antitrust battles of the seventies. If the last possibility comes to pass, what would the right rules be?

Some folks have suggested that the only real answer is for the government to break Microsoft up into two or three parts, with the operating systems far apart from the applications. My problem with this solution is that I'm not quite sure where the line should be drawn.

I think the right approach is a moderate one. We need some sensible rules that don't require a whole lot of interpretation or government intervention. Some of the following ideas are things Microsoft does anyway but not always to the extent that critics would like.

All operating-system calls should be public, and they should be published at or before the time the OS is released. Of course, we'd first have to define such calls (application programming interfaces, or APIs), since "undocumented calls" were a big issue a few years ago. As far as I'm concerned, they're anything that an application would call, expressly including any and every API used by Microsoft's own applications.

All file formats should be public. This is pretty much happening already, as most direct competitors with Microsoft's applications already can read and write files written by Microsoft applications. And of course, there are third-party programs that do this (such as Inso's Quick View Plus). But there's always a question of how long it takes vendors to understand the file formats.

It should be expressly legal for other companies to write programs that incorporate APIs and file formats. Theoretically, this would let a company—when it saw a market opportunity—write a new OS that could run programs written for Windows. Or (and this might be more likely) a university or computer science department might try. This has been tried in the past: Remember Wabi, Sun's attempt to run Windows code on top of Unix? (I don't propose to change copyright laws; competitors could copy APIs but not the internal code in Windows.)

OS vendors shouldn't be allowed to force a UI or a shell on a hardware maker. Put another way, system vendors should be allowed to add their own shells, extensions, and so on to an OS. Thus, the hardware vendors could improve access handling and invent new ideas. I understand Microsoft's argument—that the OS is its brainchild—but support on new machines comes from the hardware vendor. And from the computer maker's standpoint, the product is the whole PC. Vendors should have some say about how a system looks and an ability to differentiate their PCs from others.

Nothing in an OS agreement should prohibit a hardware vendor from bundling or selling any other software. Whether Microsoft actually has such restrictions in its secret formal agreements with system vendors is a subject of debate. But some vendors feel they are prohibited from offering such products, either explicitly or implicitly, because they are afraid Microsoft will limit their access to new technology. I don't suppose any formal rule will stop this, but making it explicitly against the rules can only help.

Most of the items I'm suggesting are fairly minor. And many of them are already true to some extent. Still, these are the kind of changes that I think would be reasonable, encourage competition, and change the perception of everything being closed, yet would not hold Microsoft back from innovation.

Michael J. Miller

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PC MAGAZINE
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Volume 17
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UP FRONT

From the Editor-in-Chief 4
Pipeline 9
Letters 21
Trends 28
- IP multicasting tunes in
- HP's CEO on digital imaging
- Inside PC Labs
- Surfing by satellite

PCs 35
- Mobile PII notebooks

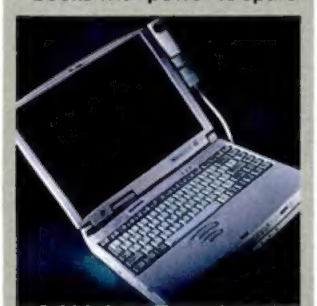
Software 36
- E-mail utilities
- MailRoom for Internet 2.3

Peripherals 37
- Flatbed scanners

Applications Development 40
- Interface builders

Networking 42
- 56K ITU V.90 modems

First Looks 45
- Seven Pentium II notebooks with power to spare



- 3Com Palm III
- Philips DVX8000
- Picture Publisher 8

Second Looks 79
- Tektronix Phaser 360: Jammin' copies
- Plasmavision 42EP

COLUMNISTS

JAKE KIRCHNER 30
BILL MACHRONE 85
JOHN C. DVORAK 87
INSIDE TRACK 89
JIM SEYMOUR 93
BILL HOWARD 97

COVER: PHOTOGRAPHS BY THOM O'CONNOR; SPOT ILLUSTRATION BY ALAN BASEDEN

COVER STORY

TAKE CONTROL OF YOUR E-MAIL

BY BEN Z. GOTTESMAN

We love our e-mail. And we hate our e-mail. But we can't remember how we lived without it. Now, though, all of us need help in managing our in-boxes, and if you run e-mail for your company, you're making decisions about mail servers and open Internet standards and whether groupware is worthwhile. No matter which way you go, we've got you covered 101

THE CLIENT SIDE

Personal E-Mail

BY STEPHEN W. PLAIN

You need more than just a place to create messages. E-mail packages have tools to help organize messages, create filters to monitor incoming mail, and automate chores 111

America Online 4.0 E-mail 113
The Bat! 113
BeyondMail Professional 116
Calypso E-mail 117
CompuServe Mail 120
email 97 128
Eudora Pro Email 4.0 128
Lotus Mail 4.52 129
MailCat 2.7 129
Microsoft Outlook 98 130
Microsoft Outlook Express 4.0 130
Netscape Messenger 4.0 151
ProntoMail Professional Edition 151
QuickMail Pro 1.5.2 153
TeamWare Embla 2.1 154

THE SERVER SIDE

Corporate Messaging

BY LES FREED

What kinds of mail and collaboration services do your users need? It may be time to think about groupware—or time to move to Internet standards 157

Mail Servers
Eudora WorldMail Server 2.0 161
IMail Server 4.0 for Windows NT 162
Infinite InterChange 3.10 162
MailSite SQL Enterprise 2.1.5 163
Mercur 3.0 164
Netscape Messaging Server for NetWare 164
N-Plex Office 1.31 168
NTMail 3.03C 168
OpenMail 5.10 169
Simeon Message Service 2.0.1 169
Sun Internet Mail Server 3.2 170
Groupware
Lotus Domino, Designer, Desktop 4.6a 171
Microsoft Exchange Server 5.5 172
Netscape SuiteSpot 3.5 178
Novell GroupWise 5.2 180
TeamWare Office 5.1 182

FEATURES

INTERNET

Web Servers

BY GREG ALWANG

It almost doesn't matter which flavor of Web server you buy, just so you get into the game. The options are all pretty good. So choose one against your infrastructure investment, in-house expertise, or content platform, but definitely choose one. Web servers have quickly become essential for doing business—whether they're handling intranet activities for you or acting as the base for your forays into electronic commerce....**184**

Apache HTTP Server 1.2.5 186
Java Web Server 1.1 187
Lotus Domino Go Webserver Pro 4.6.1 190
Microsoft Internet Information Server 4.0 192
Netscape Enterprise Server Standard Edition 3.5.1 194
Novell Netscape Enterprise Server Pro for NetWare 195
WebSite Professional 2.1 196
WebStar 3.0 197
WebTen 2.0 208

Web Server Usage 185
Suitability to Task 186
Editors' Choice 187
Performance Tests 200
Preview: AppleShare IP6 205
Summary of Features 206

PCs

The New Networked Computers

BY TAMI D. PETERSON AND ANUSH YEGYAZARIAN

Centralized computing is an old, respected idea that's finally getting dusted off and readied for use in the PC world. It can work for you **210**

Thin Clients
Boundless Technologies Inc. 218
Neoware Systems Inc. 218
Tektronix Inc. 219
Wyse Technology 219
Net PCs
Acer America Corp. 219
Advanced Modular Solutions Inc. 224
Compaq Computer Corp. 224
Dell Computer Corp. 224
Gateway 2000 Inc. 228
Hewlett-Packard Co. 229
Sherwood Network Division 229

Editors' Choice 213
Summary of Features 216
Performance Tests 222
Network Computers: Finally Real? 228

SPECIAL PULLOUT

How to Cut Your TCO

BY FRANK J. DERFLER, JR.

You can cut costs by changing your ways. We give you a bunch of things to think about in our TCO Questionnaire, and we help you lay a path with our TCO Strategy Road Map....**231**

TCO and Your Growing Network 231
TCO Questionnaire 232
TCO Strategy Road Map 233

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Net Tools

Thin-Client Networking 239
Does your network have what it takes to deploy PC alternatives?

From the Bench 257
- APC MasterSwitch
- Server Technology Sentry R-2000
- ManageExec 5.0

Internet Tools 271
Which interface works best for adding dynamic content to your Web page?

PC TECH

Grids for Visual Basic 275
Custom controls add data-bound grids to your apps.

Tutor 299
Is Internet Explorer part of the Windows OS?

Utilities 303
Free utility: Use long filenames in DOS with LFNDir.

PC SOLUTIONS

User-to-User 307
Ask Our Advisors 314

AFTER HOURS

Web Excursions 361
Journey through the Web's best bed-and-breakfast sites.

Also in This Issue

PC Magazine Marketplace 333
BusinessCard 358
Editorial Product Index 372
Advertisers' Index: Companies 373
Advertisers' Index: Products 374
Coming Up 376
Abort, Retry, Fail? 378

"A screaming-fast 3-D game board with stunning 2-D performance, too...We'll take it!" PC Computing, 12.97

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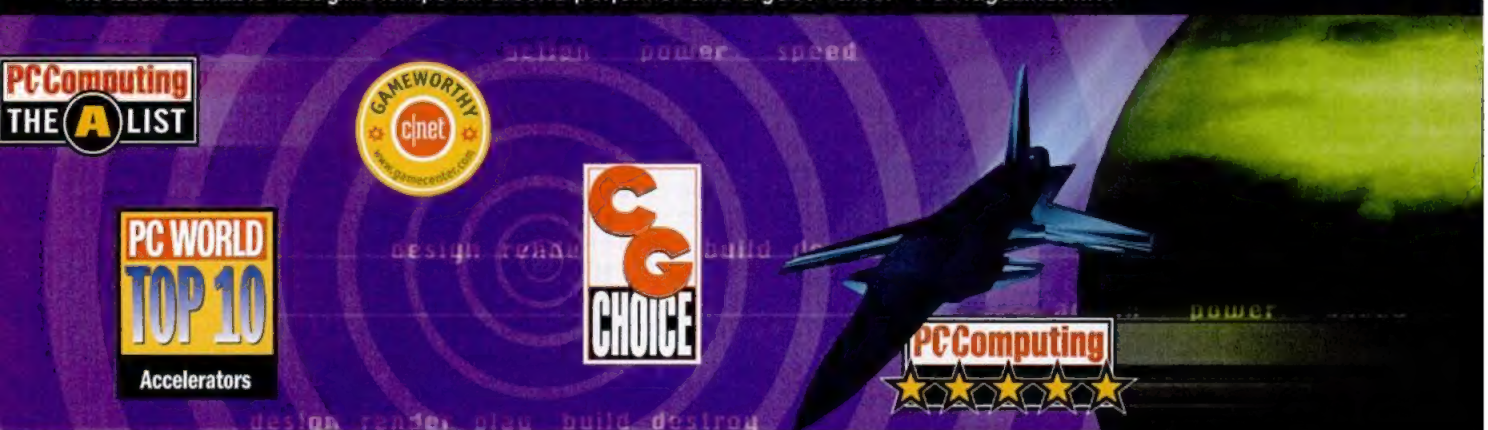

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3D Blaster Voodoo2	656
Viper V330	530
XPERT@Play	444
70 Millennium II	

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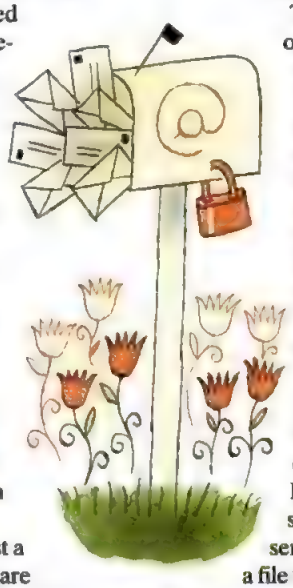
Pipeline

Overnet Delivery

The postman may never ring again. Several companies have recently launched (or plan to launch) a new kind of e-mail service that securely delivers important electronic documents you'd otherwise send via a package delivery service. "There is clearly a market for this among disgruntled e-mail users, especially those who have lost critical documents on MSN and AOL," says Vernon Keenan, an analyst at market research firm Zona Research.



At United Parcel Service (UPS), which entered cyberspace in December 1994, you can already track packages, request a pickup, and prepare international documentation. Starting this spring at *www.exchange.ups.com*, the company will offer two Internet delivery services: UPS OnLine Dossier and UPS OnLine Courier. UPS Online Dossier double-encrypts documents and uses digital certificates to verify identities. The service also provides delivery confirmation, insurance, and validation through accounting firm Deloitte & Touche, one of the parent companies of NetDox, the developer of Online Dossier.

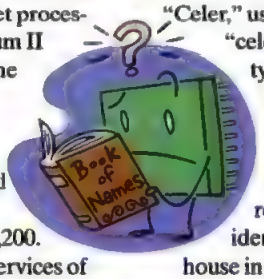
The software is based on a *container* concept, wherein a *dox* (digital box) contains such elements as text, images, and video. The program encodes and authenticates the dox, then transmits it over the Internet. You pay on a per-use basis.

Tumbleweed Software's application Posta is the engine behind OnLine Courier, the less secure of the two services. Posta uploads a file to a server and then sends an e-mail notifying the recipient of a Web address for accessing the file.

E-Parcel *(www.eparcel.com)* also offers a service that securely delivers and tracks secure files of all kinds and sizes.

Name That CPU

Intel spent much time and money naming its upcoming low-cost value-market processor, Celeron, a Pentium II stripped of its L2 cache and plastic casing. Released in April, the processor is designed for so-called Basic PCs priced between $800 and $1,200.



Intel enlisted the services of Lexicon Branding Inc., which had named the Pentium four years earlier. Pronounced "seller-on," it's the amalgam of three word roots: the Latin *celer*, the Old English *cell*, and the common suffix indicating a unit, *on*. "Celer," used in the word "celerity," means rapidity of motion or action and implies swiftness and speed. The Latin root *cella* refers to a small room; *cell* specifically identifies a religious house in Old English. In the words of Intel, it's associated "with a small, integral unit and hints of a living force."

ILLUSTRATIONS BY CYRIL CABRY (TOP), DAVID BAMUNDO (BOTTOM)

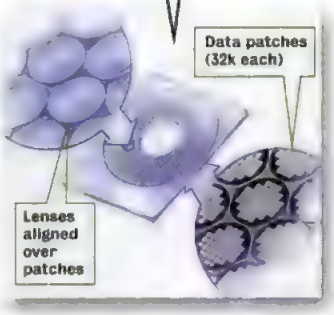
You've Got Good Connections

26% of respondents to a recent poll at PC Magazine Online told us that they surf the Web with ISDN or faster connections, strongly suggesting that many of you spend a lot of time on the Web while you're at work. Another 22 percent connect at 56K, while 52 percent connect at 33.6K or slower.

Wond-OROM-a

Walkman, Discman, Cardman? A new storage technology called optical read-only memory—OROM, for short—that's designed to hold music, Nintendo-like games, and software for handheld organizers—is set to debut this summer. Engineers at Ioptics, based in Bellevue, Washington, have come up with a radical approach to data storage that gives handheld electronic gadgets up to 128MB of storage capacity.

OROM doesn't use any spinning parts to access data. Instead, it uses light. Data is recorded on the card in 5,000 2-D images called *data patches*. Each patch contains 23K of data. When the card is inserted in the reader, it's aligned over an array of organic light-emitting diodes, each assigned to a particular data patch. To access information, the diode illuminates the data patch, which transmits an image of the data that's read onto an image sensor. Access time is 10 milliseconds, about the same as a typical hard disk and ten times faster than a CD-ROM drive.



The system's low power, portability, and low cost (about 2 cents per megabyte) seem promising. "What the CD did for large systems, this will do for small systems," says CEO Fred Hanson, CEO of Ioptics.

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Getting The E-Mail Message — This issue's cover story on communications strategies continues online, with downloadable versions of our performance tests.

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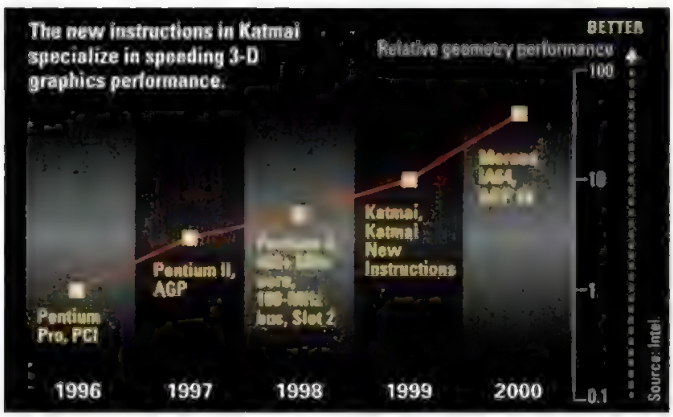
Pipeline

Intel's Next Stop: Katmai

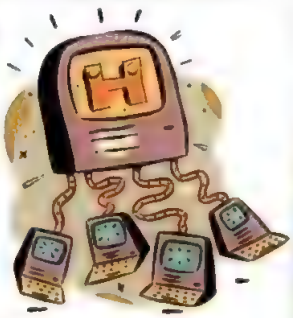
In the past, trade publications—never Intel itself—leaked information on future chips. With Katmai, the next Pentium II desktop processor after Deschutes, Intel has augmented press rumors with its own public statement a full year before the chip's arrival. Katmai, named for a volcano in Alaska, will arrive in the first half of 1999. Built around the Pentium II core, the chip will be the first processor to use what Intel calls "Katmai New Instructions Technology."



MMX Technology, which debuted early last year in the Pentium with MMX Technology, consists of 57 new *x*86 instructions to accelerate multimedia functions. These instructions, which use a single-instruction multiple-data (SIMD) architecture for integers, exhibits performance improvements only when used with software specifically coded to take advantage of MMX.

Katmai New Instructions Technology is also SIMD-based, but it deals with floating points rather than integers. Its primary duty is to enhance 3-D rendering. Intel has already released the 70 new instructions to developers who have been working on the software for almost 12 months. The software will hit the market at the same time as the chip.

The NC Alternative



Network Computers—thin clients designed to run applications from network servers—haven't lived up to their rosy expectations. This summer, however, Microsoft plans to deliver its NC alternative in Windows Terminal Server, code-named Hydra, which the company hopes will validate its own thin-client concept.

Several companies, including Federal Express and Sony, have pledged to adapt Microsoft's solution for off-loading computing tasks to servers. Microsoft sees Terminal Server breathing life into older machines. "Traditional 32-bit Windows-based PCs provide great flexibility, but customers have also asked for a way to capture the benefits to legacy desktops and terminals," says Mike Nash, director of platforms at Microsoft.

The companies currently testing Terminal Server are using the machines as text-based terminal replacements, for point-of-sale applications, and for delivering Windows-based applications to non-Windows desktops.

THIS ISSUE'S CONTRIBUTORS: *Angela Hickman, Carol Levin, Cade Metz, Sebastian Rupley, and Don Willmott.*

ILLUSTRATIONS BY HARRY CAMPBELL (BOTTOM LEFT), CHRIS SHARP (TOP), STEVE WEEK (BOTTOM RIGHT)

Chat Is Where It's At

Web users' habits are changing profoundly, says Yahoo! chief Jerry Yang, and the changes will quickly transform the Web from a publishing medium to a community medium. "Today, users aren't surfing as much," Yang says. "Instead, they're staying at sites where they find quality content," he adds. Increasingly, Web users themselves are creating content in the form of moderated forums within online communities.

The shift away from surfing is likely to have a huge impact on marketing and e-commerce, but how can marketers leverage the changes? Get the chats going. Yang encourages community building through moderated chats about products and services. These efforts could leverage the Web's rising critical mass. Yang notes that over 100 million people will be on the Web in 1998, up from 20 million in 1995.

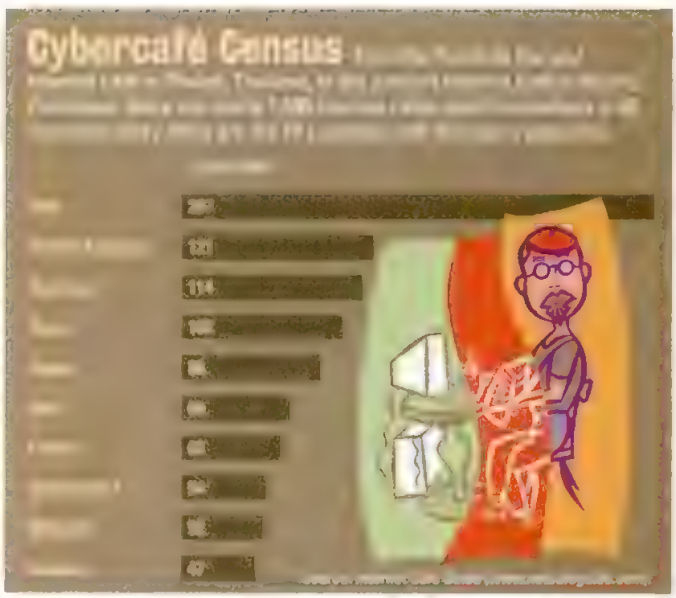
Top-Selling Games

1. **Deer Hunter** GT Interactive
2. **MYST** Broderbund
3. **Riven** Broderbund
4. **Flight Simulator 98** Microsoft
5. **Quake 2** Activision
6. **Galaxy of Games** GT-Slash
7. **Age of Empires** Microsoft
8. **Links LS 98** Access
9. **Tomb Raider 2** Eidos
10. **Wheel of Fortune** Gametek

Source: Computer Intelligence Infobeads, January 1998

Pinstriped Bikini

Be sure to wear your best swimsuit the next time you hit the beach: Your next job could depend on it. In an effort to get the first crack at a small but growing pool of skilled job candidates in information technology, job recruiters from the nation's top high-tech companies, including IBM, hit Panama City Beach, Florida during spring break in March.



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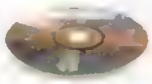

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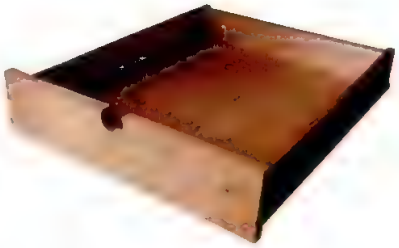

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Letters

CANDY APPLED

I would like to congratulate you on an unusually fair review of the Apple MessagePad 2100 ("The Ultimate Personal Peripheral," March 10). Apple products are seldom given credit for their superior design in the personal computing press and are often dismissed because of nothing but the reviewer's "Windowscentricity." You seem to have approached the MessagePad with an open mind and, in a short space, mentioned quite a few of its class-leading features.

RICHARD MAGUIRE BRAINE
London, England

On one hand, I was pleasantly surprised to see at least some recognition in your magazine for the Apple MessagePad 2100 (even a cover shot). On the other hand, I found it a bit odd that two of the three Editors' Choices got lower or equal marks in the Suitability to Task ratings. As usual, the reviewer appears to have had a hang-up about the large size, forgetting the power and screen size that come with it.

JOHN B. MOORE
via the Internet

While the Apple MessagePad 2100 did earn high Suitability to Task ratings in our review of handheld devices, our Editors' Choice selection criteria also took account of size, price, and sheer ease of use.—Ed.

ACCURATE SPEAKING

In general, I enjoyed your reviews of ViaVoice and Dragon NaturallySpeaking ("Watch What You Say," March 10). But I think you missed two key points. I have had ViaVoice Gold since early January. It serves well with regard to many of the points you questioned, and I feel that you should have evaluated this version of the product before writing the article. The second key point was not even covered by your article. ViaVoice permits use by more than one individual; Dragon does not. For me, this was a deciding factor. In my opinion, ViaVoice Gold now exceeds 90 percent accuracy. Compared with my typing skills, this is a twofold improvement.

MAL OCHS
via the Internet

You did all your testing using a Pentium/200 with 32MB of RAM—not a very strong PC. When it comes to dictation, CPU power and memory size play an extremely important role. I believe that it is possible to get 95 percent accuracy or better using a stronger CPU such as a Pentium II/300. Also, as far as I know, some of the speech engines are MMX-optimized. It would be interesting to see the relationship between CPU power and recognition accuracy.

ILAN SHAMIR
via the Internet

Congratulations on a fair review of the Apple MessagePad 2100.

CPU power and memory size, though important for speech recognition software, are not quite as important as they used to be, according to the vendors in our roundup. Speech recognition, in existence since the 1950s, used to require a large amount of CPU power to be able to process the complex algorithms used to interpret speech. The Pentium is deemed the first processor capable of handling speech algorithms.

The version of Dragon NaturallySpeaking that we reviewed had a minimum requirement of a Pentium/133 with 32MB of RAM (for Windows 95), not necessarily optimized for the MMX. But ViaVoice specified a Pentium/150 or a Pentium/166 with MMX as its minimum requirement. Both vendors claim that memory and processor size do not make a difference in accuracy, but that they do affect the speed at which speech is recognized. The vendors stress the importance of an approved sound card and acceptable audio quality to achieve the most accurate results.—Ed.

I enjoyed the review of voice recognition and text-to-speech (TTS) software. I have been trying to track down a simple TTS implementation for Windows 95 for months now: the ability to have Windows 95's system messages read aloud. Right now, I have sound bites attached to system events. I'd prefer to have the text in those windows read aloud, so that the sound attached to such events actually has some meaning. I have contacted several companies and looked through Microsoft's Web site, and I have not been able to find anything that performs this very simple task.

JOSEPH PRISCO
Ithaca, New York

NOT OMNIPOTENT

I laughed when I read the article in which you chose the Philips OMNI/12 as the CD-RW drive Editors' Choice ("To Write or Rewrite?," March 10). It may indeed be a fine drive. But some who buy the OMNI/12, from what I've heard, may get a rebranded Ricoh MP6200A, which has been plagued with problems. The number and breadth of the problems drove one person to create a private Web site devoted to helping users who are trying to get their drives to work. The site directs you to a Ricoh Web site to download firmware upgrades that fix some of the problems with the drive. The need for this useful Web page arose because Philips had absolutely no support on its Web site for these problems. Philips does have a toll-free number, although it normally takes me more than 2 hours to get through.

NEIL BORKOWICZ
Plymouth, Michigan

In the review, you stated that a SCSI source drive is required for effective audio duplication. Can I assume that the speed of the IDE on an ATX motherboard does not solve this problem? Does copying from CD-R to hard disk, then from hard disk to CD-R, using the CD-R as both source and target, solve the audio recording difficulties? Does the latter method require a SCSI CD-R?

JACK BEREN
via the Internet

We discussed these issues in the article, but to recap: The speed of the IDE channel does not matter for ATAPI CD-ROM drives, since nearly all systems have dual IDE interfaces of the same speed. ATAPI CD-ROM drives do not use advanced Ultra-DMA transfers. Yes, first copying to the hard disk and then to the CD-R will work. Obviously, that's a two-step procedure. In the cases we have seen, the latter method does not require a SCSI CD-R.—Ed.

WHO PAYS FOR MAKING CHEAP PCs?

Jake Kirchner states that low-priced PCs mean lower profits for vendors, then asks, "Who will be able to pay for the research to make computers more reliable and easier to use?" ("PC Prices: How Low Can They Go?", March 10). Vendors assemble computers from components manufactured by other companies, then load an operating system, followed by programs. Reliability depends on the quality of the components, and ease of use depends on the software running the components that together make up the PC. I think it's obvious that responsibility for research falls on hardware manufacturers and software authors, not vendors.

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Harrisburg, Pennsylvania

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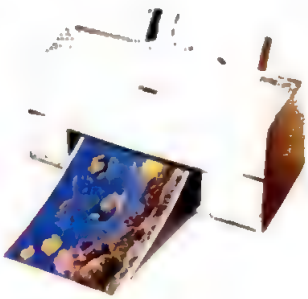

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Letters

When I first read Kirchner's column, it made sense. Later I realized that Kirchner was way off base. VCRs are not as bad as he thinks; mine never crashes and has worked for years without locking up. But the really big issue is innovation. The low prices on sub-$1,000 PCs hurt companies like Dell and Gateway, even though they don't produce the innovations. Interface innovations come from companies like Microsoft and Netscape. True, hardware innovations come from companies like Intel, which are affected by lower prices and profits. But for what I do, software innovations are much more important than hardware.

RONNY RICHARDSON
via the Internet

I think Kirchner omitted the real reason PC penetration is greatest in households with the highest incomes. The market stats indicate what is quite obvious: PCs are purchased for what they were designed to do—run applications. People with high incomes have a greater need to remain organized and have higher demands placed on limited time. Let's face it, the best tool for the job is still the PC. As for Kirchner not believing that "people with high incomes are necessarily more capable of operating computers than the rest of the world," I agree. But those with high incomes likely get high-quality training at their places of business and are likely know how to use PCs prior to installing them in their homes.

BERNIE KLATZKO
Toronto, Ontario, Canada

INUNDATION AND INNOVATION

I consider Michael J. Miller's suggestion that "Microsoft's biggest achievement may be its ability to add features to its OSs while remaining compatible with the applications and machines that came before" ludicrous ("Who Drives Innovation?", March 10). I have a PC with Microsoft Windows NT 4.0, and I downloaded the latest version of IE4. I tried running Active Desktop but had to uninstall IE4 because it continually stopped responding. Microsoft can't even make current applications run with its current OS. I'm tired of reading about the latest innovations coming from Microsoft and Intel, especially since these "innovations" were developed elsewhere. But unlike Intel, Microsoft doesn't market its OS as the greatest thing since man invented the wheel. This may come as surprise to you, but there are alternative operating systems for PCs. There is plenty of innovation in the OS arena, as exemplified by Linux.

DANIEL DUNN
Cheverly, Maryland

There's another obvious yet overlooked reason for the lack of innovation besides those mentioned in Miller's editorial, at least in the case of office applications, and that is profitability. The one thing that Microsoft has done in that category is slash prices, thanks to the steady profit stream from operating systems. Compare what you pay for a full suite of applications now with what you paid for them 15 years ago. And don't forget that along the way software has become vastly more complex, making development costs higher. We've all benefited from the lower costs, but the potential profit incentive that inspired numerous competitors simply isn't there anymore.

LARRY HYMO
Athens, Georgia

SPECULATION ABOUT CE INTEGRATION

In "Start Your Engines" (Trends, March 10), you write that "there are rumors that Windows CE will run in pens and watches and even that it will be woven into clothing." I don't know whether that statement is intentional humor or a subject for Abort, Retry, Fail?, but I can think of several consequences: First, instead of bug-ridden software, we'll have moth-eaten software. Never buy off the rack from lot numbers starting with 1 or ending with 0. Second, Windows will be multithreaded at last. Third, fashions will change more frequently, in pace with technology. Fourth, glasses and hearing-aid manufacturers will have to send new product samples to Redmond for that "Works with Microsoft Windows" label. Fifth, Intel will start making Pentium belt buckles, tie clips, and other accessories. Sixth, tailors will need software-engineering degrees. And woe betide the thrifty souls who attempt to stitch their own clothing. Last, check out what those cleaning instructions say—wash-and-wear they won't be.

ALAN WOOLF
via the Internet

When I read "Start Your Engines," a number of possible future statements flashed into my mind: "I can't wear that—the blouse is not compatible with the skirt." "Are these socks Plug and Play?" "What do you mean I have to upgrade my whole wardrobe before I can wear this belt?" "I'm sorry I'm late, but my shoes crashed on the way over here." "Excuse me for a second—I have to reboot my pants." "Ever since I lost weight, my clothes don't have the capacity to hold all my files." Is this really something we should be looking forward to?

PERRY OTIS
via the Internet

Corrections and Amplifications

In the March 10 Trends/Peripherals article "The Next Notch Up" (page 37), we described CAV (constant angular velocity), a technology used in CD-ROM drives, incorrectly. CAV spins the drive at a constant rate, so that the disk travels faster under the head at the outer track zones and slower in the inner track zones. By contrast, CLV (constant linear velocity) varies the speed of the CD-ROM motor, so that the medium passes at the same speed under the drive head in both inner and outer track zones. All drives discussed in the article use a new technique (sometimes known as *intelligent spindle-speed control*) that combines CAV and CLV technology. On the same page, the article "How to Clone a CD-ROM" misstates the way in which the Princeton CDXpress is used to copy CD-ROM disks. In fact, both the source and target disks are placed in the unit's tray, one after another. The copy process is performed entirely within the CDXpress, without the need for an attached PC.

In "Get in the Game" (March 10, After Hours), the cost of Mplayer's premium service, Mplayer Plus, is incorrectly listed as $39.95 per month. In fact, it costs—at most—$39.95 per year.

In the Inside Track column of February 24, Project Oxygen, the planned global optical-fiber super Internet, is incorrectly described as an IP network. Project Oxygen will in fact employ a worldwide ATM switching fabric, which will allow it to transport traffic transparently, based not only on IP but also on all other ITU-recognized digital standards.

Ceilidh 2.0, from Lilikoi Software, listed in the sidebar "Players in the Field" ("Meeting of the Minds," February 24), is available for the following platforms: AIX, BSDI, Digital Unix, Free BSD, Irix (5.3 and 6.2), Linux (*x86* and DEC Alpha), MacOS (*68k and Power PC), MkLinux, OS/2, Solaris (Sparc and *x86*), SunOS, Windows 95, and Windows NT. Lilikoi can be reached at 619-405-4247 or *www.lilikoi.com*.

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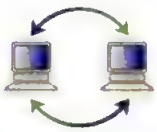

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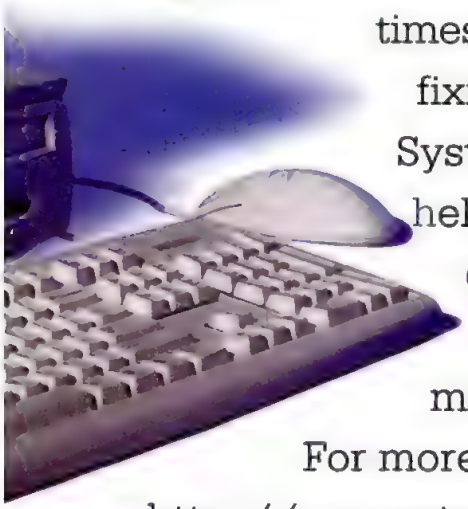

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Trends

Multicasting Tunes In

Watch live concerts, sports, and conferences without the wait.

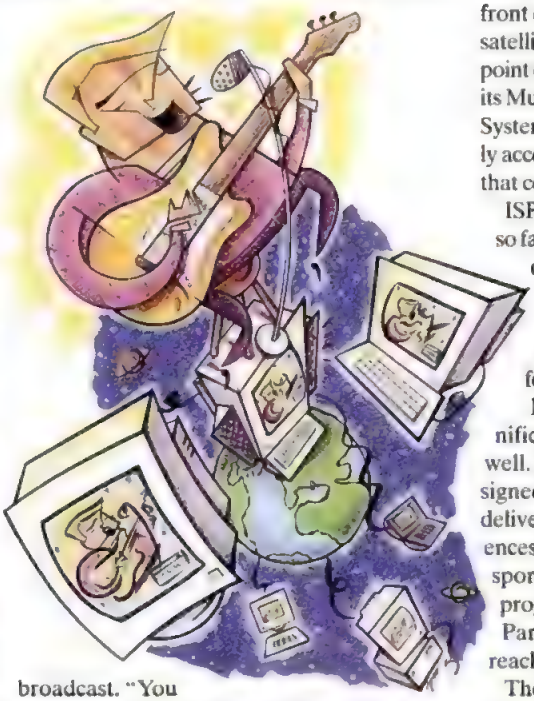
When it comes to eating up bandwidth, corporations are pigs. Intel CEO Andrew Grove recently pointed out that the capacity to consume bandwidth grows many times faster than the capacity to supply it. By that logic, even high-bandwidth technologies such as ADSL, ATM, cable modems, gigabit Ethernet, and satellites will fail to provide enough.

IP multicasting—a networking technology that reduces traffic by delivering a single stream of information to thousands of recipients simultaneously over whatever bandwidth is available—has emerged slowly over the last decade. NASA space shuttle launches and a Rolling Stones concert were some early multicast events. Now the industry is in a state of hyperactivity, with multicast delivery of live sporting events, news bulletins, conferences, and software in the works.

Recognizing the inevitability of bandwidth congestion way back in the late 1980s, a group of Internet pioneers working in the scientific research community set out to develop a way to alleviate traffic. They built the Mbone (short for IP multicast backbone)—portions of the Internet equipped with so-called *mrouters* that distribute and replicate a single data stream to multiple destinations.

Networking companies such as Cisco Systems have built multicasting support into their routers and switches. Developers have integrated multicasting support into operating systems. Slowly but surely, ISPs are upgrading their equipment. And marquee producers, including the Walt Disney Co., are taking their first steps into multicasting territory.

Companies can realize the benefits of multicasting on a large scale, when, for instance, thousands of people need to view a live video broadcast. "You cannot scale the delivery of information—text, graphics, audio, video, software—from a single source to a large number of recipients without IP multicasting being in place," says Martin Hall, chief technology officer at Stardust Technologies and the head of the IP Multicast Initiative.



That's because most of the Internet is based on a one-to-one, or unicasting, architecture. But the inherent inability of this model to scale to large numbers of recipients means that bandwidth-intensive applications can bring a corporate intranet to its knees. The early efforts at push technologies were prime examples of bandwidth pig-outs. Network managers were none too pleased with the results. (The latest version of PointCast Network, Version 2.5, supports IP multicasting.)

SATELLITES MOVE INTO POSITION

Satellite companies, including Gilat, Hughes Network Systems, and Intelsat, are at the forefront of providing IP multicast services, since satellites are well suited to the point-to-multipoint distribution. Intelsat recently announced its Multicast Internet Caching and Replication System, which collects content from frequently accessed Web sites and efficiently transmits that content via satellite to "cache sites."

ISPs are testing the waters as well, although so far only the largest ones have made significant commitments. Last fall, UUnet Technologies rolled out UUCast, which enables content providers to send live audio, video, and real-time information to large numbers of subscribers. MCI and RealNetworks have made significant commitments to multicasting as well. Their Real Broadcast Network is designed for Web sites needing superefficient delivery of live audio and video to mass audiences. AudioNet also offers live multicasts of sports events, radio broadcasts, and other programs to subscribers of its ISP Multicast Partners: Erol's Internet, GTE, IDT, Inreach Internet, and The Microsoft Network.

The Walt Disney Co. recently inked a deal with Precept Software to multicast video over the Internet. Using Precept's IP/TV software, Disney plans to launch a multicast channel with unique movie-related content to drive the deployment of multicasting, says Precept's CEO, Judy Estrin.

CNBC Dow Jones Business has used multicasting from the get-go to deliver live audio and video of market-moving events directly to desktops. Although companies are increasingly looking at multicasting as a viable way to distribute content, "it's not that easy," says Mike Wheeler, president of CNBC/Dow Jones Business Video Services. He adds "The onus is on the ISPs and corporations to configure their routers for multicasting."—*Carol Levin*

Liberating Bandwidth

In the unicast model, the server sends multiple copies of the same video stream, one to each client that requests it (clients B and C).

Source: Cisco Systems

In the broadcast model, the server sends one copy to all the users on the network, whether they want to receive it (clients B and C) or not (client A).

In the multicast model, the server sends one copy to a group address. Clients that want to receive it (clients B and C) tune in. Any client that doesn't want it (client A) doesn't receive it. This eliminates redundant traffic.

ILLUSTRATION BY PAUL STODDARD

Images on Tap

Home book printing and photo fax machines are on the horizon.

According to Hewlett-Packard chairman Lew Platt, long-term predictions about technology are useless. In a recent address, he cited some futurists in 1890 who predicted that Los Angeles would be abandoned by 1930 because too many horses would clog the streets. Technology rendered that prediction particularly worthless.

But Platt does have a number of interesting short-term predictions, which, not surprisingly, could help him sell more printers. In particular, he foresees a coming revolution for digital imaging, fax technologies, and image archives on the Web.

Lew Platt, CEO of HP, predicts that digital imaging will revolutionize publishing.

"Color printing of digital images is now so sophisticated that professionals have trouble discerning a digital image from one shot with a traditional camera," he said. The next steps include advanced ways of archiving, retrieving, and transmitting the images—and many involve the Web. Platt envisions a "photographic fax machine of the future," which would fax digital image files rapidly.

Bandwidth is the current barrier to such a product. But Platt pointed to promising technologies such as Kodak's FlashPix, which saves digital images in multiple resolutions, detects the capabilities of the machine receiving the information, and sends only the data needed.

In the area of archiving and retrieving digital images, Hewlett-Packard is working on face-recognition software that will search for and match images. The L.A. County Sheriff is currently using the technology to match digital sketches of criminals to mug shots.

HP's chief also believes that digital imaging will revolutionize publishing. A bookseller such as Amazon.com might avoid shipping costs by sending books as digital image files, to be printed in color at the receiving end.

The inevitable repository for most digital images is the Web, which Platt applauds, but he also warns of the Web's social impact. "Television, too, was supposed to revolutionize the way we communicate and learn, but instead its content has tended toward the least common denominator of entertainment."
—*Sebastian Rupley*

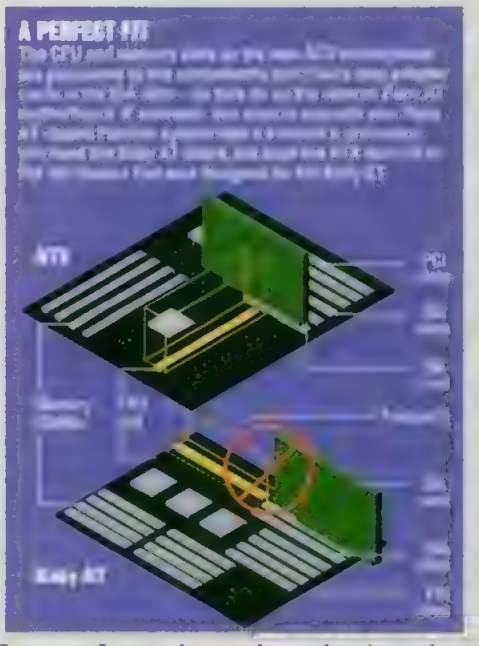
INSIDE PC LABS

The Phantom Upgrade

WANT TO UPGRADE A PENTIUM SYSTEM TO A Pentium II? PC Labs decided to do this for our feature, "When Do Upgrades Make Sense?" (April 21, 1998), in which we tested 10 different upgrade scenarios with the 486 and 29 different scenarios with the Pentium/100. You can read the story on our Web site at *www.pcmag.com*.

To upgrade our Pentium/100 to a Pentium II/266, we had to replace the motherboard. We set out to acquire a Baby AT Pentium II motherboard with the newest Intel chip set—the 400LX—but soon found that searching for the motherboard was like chasing a phantom.

Although you'll most likely need a Baby AT motherboard when upgrading from a Pentium to a Pentium II, major manufacturers aren't producing Baby ATs with the 400LX chip set. Finding one was difficult but not impossible. (We located two from small third-tier vendors.)



On the other hand, Pentium II motherboards with the older 440FX chip set are easy enough to come by. In fact, they are made by all the major vendors including AMI, Asus Computer International, Intel, Micronics, SuperMicro, and Tyan. We ended up using a Tyan Tahoe AT S1680S, a Baby AT model with Intel's older 440FX chip set.

When upgrading a PC or when purchasing a new one, you should request the 440LX. The original Pentium II chip set, the 440FX, was designed for the Pentium Pro processor. Consequently, the 440FX doesn't support today's most popular features, such as SDRAM for speeding up memory access, Ultra DMA33 hard disks to speed up hard disk access, or Advanced Graphics Port (AGP) to accelerate video that utilizes 3-D textures.

Except for the most recent Pentium MMX systems (that you wouldn't be likely to upgrade), most Pentium systems come with a Baby AT motherboard that measures 9 inches by 10 inches. The card slots are positioned on one edge of the motherboard, and the rest of the components are behind the slots.

For years, it was a problem to fit full-size cards into some of the slots, because the heat sinks or memory modules block the cards. The ATX motherboard and its cousin, the NLX motherboard, solved this problem. The ATX measures about the same but shifts the motherboard 90 degrees, moving the slots to the longer edge and the processor and memory off to the side where they don't get in the way. The NLX motherboard uses a similar layout but puts the slots on a riser card.

Our difficulty in obtaining the motherboard we wanted wasn't due to any technical difficulties vendors have in designing or manufacturing the product, but rather to market economics. The consensus from the motherboard vendors we polled was that the board we wanted isn't a prudent economic choice for people upgrading their systems. Most PC manufacturers have moved to ATX/NLX motherboards, and for a vendor to make Baby AT motherboards would mean catering to only a small upgrade market. It takes skill, patience, and substantial cost—nearly $900—to upgrade a motherboard, processor, and memory. At that point, you're getting close to the cost of a new system.—*Rich Fisco*

Surfing By Satellite

Countdown to Internet-in-the-sky services from Teledesic and Celestri.

Chances are you don't have a satellite dish in your yard or on your roof to connect to the Internet, but analysts say a satellite dish *is* in your future whether you access the Internet at home, in the office, or on the road. Compaq chief Eckhard Pfeiffer, in fact, predicts that in the future most homes will feature two-way satellite communication, of which Internet service will be one part.

Low-earth-orbit (LEO) satellites are going to make it happen. Motorola's Iridium network—a constellation of 66 satellites that will provide worldwide wireless access for voice, data, fax, and paging services by the end of the century—will be followed by another network of satellites called Celestri. This two-way satellite network will broaden Motorola's offerings to include Internet access, as well as other broadband applications. Celestri will consist of 63 satellites in low-earth orbit—about 868 miles above the earth—and will be operational in 2003.

In 2002, Teledesic, backed by Craig McCaw, Microsoft chairman Bill Gates, and Boeing, will begin offering two-way satellite Internet connections with speeds up to 64 Mbps on the downlink and up to 2 Mbps on the uplink. Billed as an "Internet-in-the-sky," Teledesic's 288 satellites will cover nearly 95 percent of the earth's landmass.

International users in remote areas will benefit the most from the service. "The United States is well wired with Internet technologies," says Julia Pickar, an analyst at market research firm Zona Research. "Internet access via satellite is especially useful for remote but active areas, such as Australia," she says.

Meanwhile, telecommunications companies Teleglobe and Telstra have teamed up to develop a high-speed Internet connection between Australia and the United States via a hybrid cable and LEO satellites. The system will use Telstra's existing transoceanic cable for the inbound traffic to the U.S. and a 45-Mbps satellite link for the return trip to Australia.

Currently, Hughes Network Systems offers DirecPC, a satellite-based Internet service that downloads content from the Internet at speeds up to 400 Kbps. That's a whole lot faster than the typical Internet connection of 33.6 Kbps. But you have to upload data over a modem, a downside in the service that both Teledesic and Celestri will solve.—*Angela Hickman*

Company/product	Available	Services offered
Hughes Network Systems/DirecPC	Now	Internet
Motorola/ Celestri	2003	Voice, Internet, fax, videoconferencing
Teledesic/ Teledesic	2002	Voice, Internet, fax, videoconferencing

JAKE KIRCHNER

A Bit of Prevention Is Worth 2 Bytes of Cure

I recently overheard a man describing his struggle with carpal tunnel syndrome. At the end of his description of cures tried and failed and of the eventual, successful surgery to relieve the intractable pain that made it impossible to work, eat, or sleep, he concluded: "If the operation hadn't work, I was considering amputation." He was dead serious.

Thankfully, few of us have had to suffer so greatly, although just about all of us at one time or another have experienced stiff necks, sore backs, or cramped hands from excessive use of computers. Of course, computer users are not the only people who suffer from various forms of repetitive strain injury (RSI). Musicians, dressmakers, artists, butchers, carpenters and practitioners of many other occupations can damage their hands through years of repetitive activity.

There's evidence that the number of RSI sufferers may be growing because of the skyrocketing use of computers, and with more and more children using computers, the problem may be even worse in years to come. A new book by noted health writer Deborah Quilter—a longtime "RSIer"—documents that there are hundreds of thousands of new RSI cases reported every year, resulting in billions of dollars in compensation claims and lost productivity.

Quilter's book, *The Repetitive Strain Injury Recovery Book* (Walker & Co., $14.95), is a must-read for any RSI sufferer. Moreover, the chapters on correct techniques and practices for setting up computer workstations and using keyboards and mice are useful information for anyone determined to avoid RSI. They also make the book a worthwhile addition to the reference shelf of anyone who manages in a computing environment.

The book won't be without controversy in computing circles, however. "Given the risk factors and increasing occupational and recreational computer use, the question is not *if* a lot more people will get RSI, but *when* they will get it," Quilter declares.

She goes on to describe the tools of personal computing as "inherently harmful" and warns against any use of laptops and mice. She doesn't engage in finger-pointing, however, and she doesn't fall in to the trap of believing that better designs or more ergonomic technology will eradicate the dangers of RSI. After all, if a small percentage of pianists and guitarists suffer from RSI, does that mean that some pianos and guitars are less ergonomic than others?

While noting the deficiencies in design of many of the tools of modern life, Quilter accepts computers—and drills and hammers and pencils and hundreds of other instruments—as facts of life, and she devotes her book to helping users of these instruments avoid injury and to overcome or cope with any injury already incurred. Beyond her detailed advice for workstation setup, good posture, and computing techniques and practices, I applaud her emphasis on a healthful lifestyle—proper diet, effective exercise, stress reduction, and other healthful habits—as important in avoiding or dealing with RSI.

Some will find this book alarmist, its warnings of dangers overwrought, and its conclusions overreaching. RSI sufferers will find it supportive, helpful, and comforting. I found her message to be one of hope. With care and attention, we can be masters of the technology around us, not its victims.

PHOTOGRAPH BY SHONNA VALESKA

New SurgeStation™: the most advanced features ever designed by our customers

"I want to plug a telephone line and a modem dataline into the same surge protector."

"I need more outlets for peripherals."

"I need some outlets that are always on."

"I want to plug in transformer blocks and keep all outlets open."

The Challenge

Surge suppression is vital to the health of your electronic equipment. The SurgeStation™, APC's latest offering, accepts the challenge issued by APC customers to incorporate several "dream features" while maintaining the key elements and high-performance that make SurgeArrest, one of the best selling surge suppressors in the world.

Not all surge protectors are alike

Life presents many risks, most people seek out the best insurance to reduce the threat of these risks, so why would you trust the protection of your PC to some outlet strip? APC is the world leader in power protection; we provide you with premium, reliable surge protection, and the peace of mind that comes from knowing you have the best protection.

All the Features You Wanted

SurgeStation products now include: Eight outlets – three spaced to handle transformer blocks easily, a new building wiring-fault indicator, a right-angle plug to maximize your work space, and a switch large enough to be pressed on with your foot, but recessed enough to prevent accidental turn-off.

Whether you need basic protection, or the best protection money can buy, APC has a SurgeStation to meet your needs. Each SurgeStation model offers the best protection from lightning strikes and everyday power surges that can cause hardware damage and data loss. Every model carries a lifetime equipment protection policy; if connected equipment is ever damaged by a surge or lightning strike, APC will replace up to $25,000* worth of that equipment. With power problems virtually guaranteed to damage unprotected electronics, you won't find a better protection value.

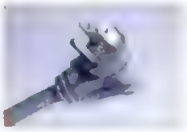
SurgeStation also comes in models with built-in telephone and built-in cable and telephone protection.

Building/Site Wiring Fault Indicator

SurgeStation is equipped with a Building/Site Wiring Fault LED that identifies dangerous wiring problems before you plug in your equipment

Protection Working Indicator

*A Protection Working LED warns you if SurgeStation circuitry is ever damaged. APC will then replace the damaged SurgeStation for free under its lifetime warranty.**



Right-angle Plug

SurgeStation's space-saving plug design allows the cord to be flat against the wall.

8 Outlet Floor Models

Eight outlets on SurgeStation floor models provide ample space for equipment plugs with transformer blocks

For Home Office/Small Office Applications

The SurgeStation series offers premium protection for small business/home office computers, high-performance stereo and video equipment, laser printers, and modems.

So join the over 8,000,000 satisfied computer users who say "ProtectME!" with APC.

Lifetime Equipment Protection Policy

*With the Lifetime Equipment Protection policy, your equipment connected to SurgeStation is protected. (*See policy for details.)*

SurgeArrest and SurgeStation

In addition to APC's best-selling SurgeArrest line, look for the following SurgeStation model options:

Telephone & AC Protection
2 Telephone & AC Protection
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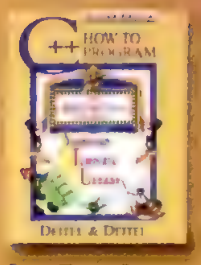

C++ How to Program, Second Edition
by Harvey M. Deitel and Paul J. Deitel

Packed with examples, exercises, projects and quotations, this tutorial offers students a chance to solve real-world problems using C++. Includes the latest additions to the language and the new ANSI/ISO C++ standard library. (Prentice Hall)

Pub. Price $51.00
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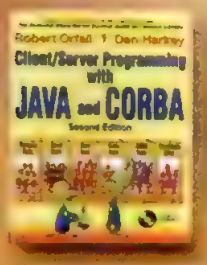

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by Cay S. Horstmann and Gary Cornell

This must-have reference provides experienced programmers with comprehensive coverage of encapsulation, AWT graphics programming, data structures and more. The accompanying CD-ROM is packed with sample programs. (Prentice Hall)

Pub. Price $39.95
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Core Java™ 1.1, Volume 2: Advanced Features
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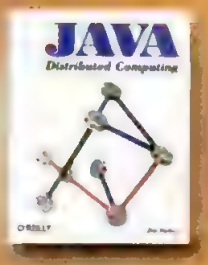

Java™ Distributed Computing
by Jim Farley

Here's an easy-to-use, practical overview of Java's tools and techniques, complete with detailed explanations of the concepts that come into play in most distributed computing situations. (O'Reilly Associates)

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Java™ Master Reference
by Arthur Griffith

Organized alphabetically and full of cross-references, this new guide provides easy-to-access information on JDK 1.1, including JavaBeans, inner classes, introspection and security. The enclosed CD-ROM includes Sun's Java Development Kit 1.1 and more. (IDG Books)

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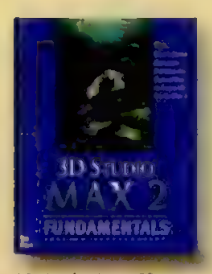

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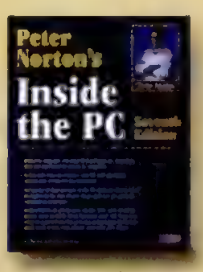

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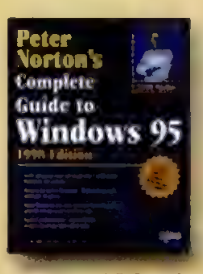

Peter Norton's® Complete Guide to Windows® 95, 1998 Edition
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Step-by-step procedures and screenshots give readers a clear understanding of the operating system and how to accomplish various tasks. Peter's Principles are expert tips on the best strategies for personalizing a system. (Sams)

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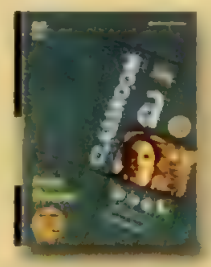

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NOTEBOOKS

Mobile PII Has Landed

Intel has just released the latest wave of mobile chips, but this time there's a twist. Both the Intel Mobile Pentium II 233-MHz and 266-MHz processors are available in two forms: Mini-Cartridge or Mobile Module. The new Mini-Cartridge form allows the processor to take up less space inside the notebook's chassis.

See this issue's First Looks roundup of seven of the first notebooks to feature the new benefits afforded by the Mobile PII processor, including integrated L2 cache and improved performance. In addition to these systems, Toshiba America Information Systems (800-334-3445, *www.computers.toshiba.com*), Hitachi America Corp. (800-555-6820, *www.hitachipc.com*), and Gateway 2000 (800-846-2000, *www.gateway.com*) will introduce PII notebooks for high-end buyers this spring.

Toshiba has introduced the mobile PII into its Tecra and Satellite Pro lines for the corporate crowd. The 233-MHz **Satellite Pro 490CDT** (pricing starts at $3,500 street) includes 32MB of EDO DRAM, a 3.8GB hard disk, a 12.1-inch active-matrix display, a K56flex internal modem, an S3 ViRGE/MX 3-D graphics accelerator (with 2MB of video memory), an IrDA port, a USB port, two PC Card slots, 16-bit sound with [illegible]ed speakers, [illegible]rosoft Win-[illegible]2-pound sys-[illegible]es with a mod-[illegible]ay that can ac-[illegible]mmodate a 20X CD-ROM module, a floppy disk drive, an optional hard disk, or an optional second lithium ion battery. Toshiba provides a three-year parts and one-year labor warranty.

The $5,500 **Tecra 780CDM** is geared toward the corporate power user who needs to run the most advanced programs. Powered by the mobile PII 266-MHz processor, the unit offers up 64MB of RAM, an 8.1GB hard disk, a 20X CD-ROM module, and an S3 ViRGE/MX 3-D graphics controller (with 4MB of video memory). The PII Tecra resembles the Satellite Pro 490XCDT (reviewed in this issue's First Looks) in terms of screen size, sound, ports, management, security features, modular bay, and modem. But like the Tecra 780DVD (also reviewed in First Looks), it adds videoconferencing features such as Intel ProShare and Microsoft NetMeeting. The 7.9-pound Tecra 780CDM has a three-year parts-and-labor warranty and a one-year warranty on the removable, rechargeable lithium ion battery pack (which offers three hours of life on full power).

ON THE MOVE: *New Mobile Pentium II notebooks from Hitachi (left) and Gateway (above).*

Hitachi has added two new models to its VisionBook Pro series. Sporting many of the same features as previous incarnations (including LED battery gauge, 16-bit sound, and an internal 56K x2 modem), the **VisionBook Pro Model 7330** and **VisionBook Pro 7550** will cost about $3,000 and $4,000, respectively.

While the Pro 7330 offers a 233-MHz CPU, 48MB of EDO DRAM, and a 12.1-inch active-matrix display, the higher-end Pro 7550 is equipped with a PII 266-MHz CPU, a 5GB hard disk, 64MB of EDO DRAM, and a 13.3-inch XGA display. Hitachi expects both units to have 3.5 hours of battery life thanks to lithium ion batteries. Each VisionBook also features a 64-bit Chips and Technologies graphics accelerator, a LAN link with an integrated 10/100 Base-T network adapter, and the ability to swap among the included 24X CD-ROM module, floppy disk drive, or Iomega Zip Drive. The variety of removable storage choices (along with the usual two PC Card slots, an IrDA port, and one USB port) makes the VisionBook Pro easy to tailor to your needs. All VisionBook Pros have three-year parts, one-year labor warranties.

Gateway 2000 is moving its entire 9100 and 5100 notebook lines over to the mobile PII. You can specify a built-to-order PII notebook system that meets your needs, ranging from the $2,899 **Gateway 5100SE** to the $4,899 **Gateway 9100XL**. The 6-pound 5100SE offers a 233-MHz CPU, 32MB of RAM, a Chips and Technologies graphics accelerator with 2MB of VRAM, a 2GB hard disk, integrated speakers, a 20X CD-ROM module, a floppy disk drive module, two PC Card slots, two USB ports, and a lithium ion battery pack that (according to Gateway) has an average life of three hours.

The 8-pound 9100XL has a 266-MHz CPU, 64MB of RAM, a 5GB hard disk, a Trident graphics accelerator with 4MB of RAM, a removable combo DVD and floppy disk drive, two lithium ion batteries, Altec Lansing speakers, and a Gateway Solo Mini Docking Station. All 5100 and 9100 notebooks come standard with 16-bit sound, a 14.1-inch screen, Windows 95 (you will be able to upgrade to Windows 98 when it's available), and a one-year parts-and-labor warranty.—*Angela Tuka*

Pentium Alternative

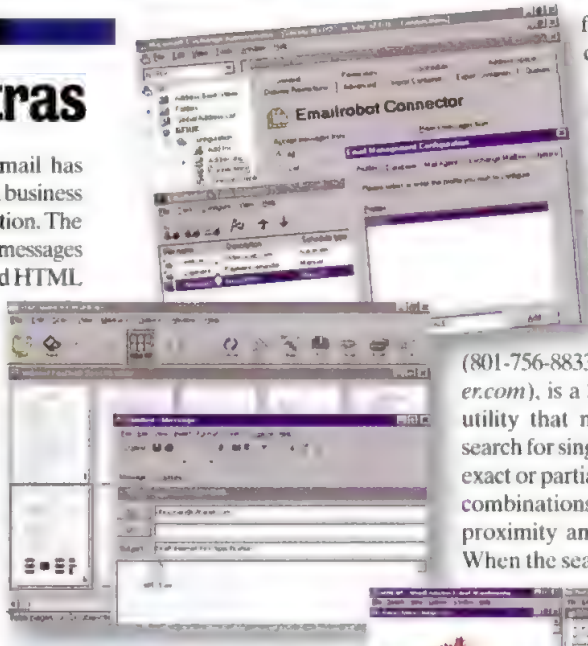
WinBook Corp. (800-657-4518, *www.winbook.com*) brings the AMD K6 to the notebook market with its WinBook XL K6 233MMX system ($1,999 direct).

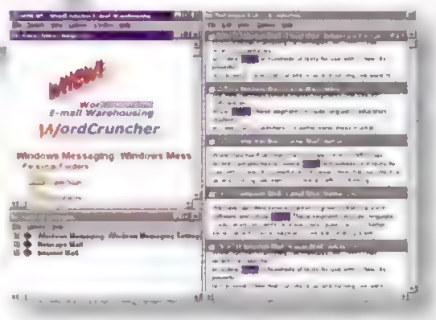
Based on the fastest mobile AMD processor currently available, the WinBook XL comes equipped with 16MB of RAM, a 2GB hard disk, a 12.1-inch display, a Chips and Technologies graphics accelerator with 2MB of VRAM, an internal 56K modem (which costs an additional $159), two USB ports, and a dual CD-ROM and floppy disk drive. A one-year parts-and-labor warranty comes standard with each WinBook notebook. —*AT*

UTILITIES

E-Mail Extras

The development of e-mail has dramatically altered both business and personal communication. The early, straight ASCII text messages have yielded to embedded HTML and fancy interfaces. As e-mail software vendors struggle to keep up with each new development, various utilities have cropped up to help deal with specific business or leisure tasks that the general packages might not be able to handle.





MAIL ASSISTANTS: *(top to bottom) Emailrobot, Mailroom for Windows, and Whew!*

The paperless office may still seem a remote possibility, but Simplify Development Corp.'s **MailRoom for Windows 4.0** (603-881-4450, *www.simplify-inc.com*) is intended to ease the transition for corporations. Priced at $79 per user (five-user minimum), this desktop document imaging application enables you to scan, process, and distribute paper documents via network fax and e-mail applications and the Internet. MailRoom integrates with such network applications as Optus FACSys, Omtool Fax Sr., RightFAX, and Microsoft Exchange. The recipient of a scanned paper document can view the document using either a standard Web browser or a fax machine with an Internet address.

Documents designed for viewing via a Web browser are delivered directly to your e-mail inbox; clicking on the attached file launches the document in the Web browser. By supporting the Internet fax format, you can send scanned paper documents, computer faxes, and Windows files through the Internet or to a fax machine with an Internet address.

To further regularize electronic communication, GFI Fax & Voice Ltd. (888-243-4329, *www.emailrobot.com*) has created **Emailrobot for Exchange/SMTP**, a package that automates and manages a company's corporate and Web site e-mail ($495 for the Small Business version, $749 for the Corporate version, and $1,495 for the Enterprise version). With Emailrobot's assistance, your company can provide more timely responses to inquiries, track and view e-mails, share e-mail workloads, monitor communications, and automate follow-ups on submitted Web forms and e-mail inquiries.

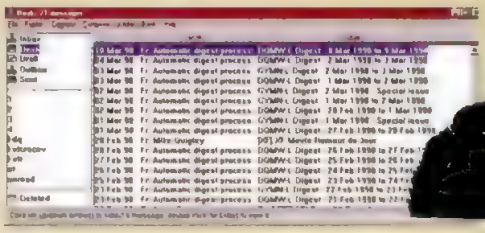
Do you remember reading an important e-mail message, but you forget which of your 3,000-plus e-mails it was? **Whew!**, new from WordCruncher Publishing Technologies (801-756-8833, *www.wordcruncher.com*), is a $9.95 e-mail search utility that may help. You can search for single words, word lists, exact or partial phrases, and word combinations. It also supports proximity and fielded searches. When the search term is located, the program provides a Reference List that shows a paragraph from the message with the search term(s) highlighted. Whew! automatically creates and maintains a searchable index containing every e-mail message on your machine. The program supports Microsoft Outlook, Exchange, and Internet Mail; Netscape Mail 3.0 and 4.0; Eudora 4.0; and cc:Mail Version 8.0 (using Windows Messaging).

Are you a long-time user of CompuServe who'd like to export your data out of CompuServe's proprietary database structure? CS2Exchange Software (540-786-9881, *www.cs2exchange.com*) offers a $25 solution called **CS2OutlookExpress**, which handles the conversion of your e-mail data from CompuServe 3.0 to Microsoft Outlook Express 4.0. Not only can you use this package to import e-mail into Outlook, you can also import forum messages and threads, news stories, and CompuServe articles. Addresses stored in your CompuServe Address Book are reformatted to include CompuServe's domain name.

Expert Software's $15 **Animated E.Mail** (305-567-9990, *www.expertsoftware.com*) has over 300 images and backgrounds to jazz up your mundane e-mails. Selecting still or animated images for inclusion in your e-mail is a drag-and-drop procedure. A background melody can be chosen from over 30 musical tracks, and the 13 special effects include orbit, tornado, whirlpool, and sawtooth patterns. The finished e-mail can be previewed in full color and animation.—*Sharon Nash*

Fastest E-Mail in Town

Sometimes, less really is more. Case in point: Sierra Solutions' $55 **MailRoom for Internet 2.3** (310-478-2531, *www.sierrasol.com/sierrasol*), an unusually agile POP3 e-mail client.



The first thing you'll notice about MailRoom is its simple, elegant design. MailRoom may lack the fancy graphical interface and HTML support indigenous to other e-mail clients, but the intuitive layout and ease of navigation more than compensates for that. The split-screen format shows your mail folders in the left-hand column, while the e-mail messages filed in the selected folder are displayed in the space to the right.

Those interested in speedy navigation will appreciate the fact that the drag-and-drop interface also lets you read and manage your e-mail without making your hands leave the keyboard. Simply press Enter (or double-click the mouse) in order to read a message. To file the message, you push Insert and then scroll through the available folders or create a new folder. Another bonus: Messages are stored as text files, and since the database structure of the folders corresponds with the folders you see in Windows Explorer, you can easily copy data from one installation of MailRoom to another.

New to this version is support for long folder and file names, sort buttons to the main window (so you can sort your mail by name, date, or subject), and an improved full-text search mechanism.—*Melissa J. Perenson*

TransPort XKE Feb. '98 | Powerdigm XSU Jan. '98 | Millennia XKU 300 Sept. '97 | Millennia XKU #4 Power Desktop Jan. '98 | Millennia XKU Jan. '98 | Millennia Pro2 200 Sept. '97 | TransPort XKE 166 Aug. '97 | Customer Service, Support & Reliability Nov. '97 | TransPort XKE Oct. '97

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Portable Solutions

Higher power. The Micron™ TransPort® XKE has made a name for itself as an incomparable, high-performance portable PC. It's won three *PC Magazine* Editor's Choice awards — and with good reason. The TransPort XKE sets the pace for high-end portable power. The XKE features an Intel 233MHz or 266MHz Pentium® processor with MMX™ technology, and is upgradable to 192MB EDO RAM. Micron gives you the only portable with award-winning Dragon NaturallySpeaking Personal voice recognition software standard. The TransPort XKE has never been faster or more powerful. And, it's never been more affordable.

Light and bright. The Micron TransPort VLX puts more power in a no-nonsense portable. Named *PC Computing's* 1997 Workhorse of the Year, the TransPort VLX sets a new standard in portables. It's flexible. Lightweight. And it's powered by an Intel 166MHz Pentium processor with MMX technology. You can get it all for an unbeatable price, because the TransPort VLX starts at a mere $1,399! Call us now and imagine the places you'll go.

TransPort VLX

166MHz Intel Pentium processor with MMX technology
16MB EDO RAM
2.1GB hard drive
12.1 TFT SVGA, 800 x 600 display

256KB L2 pipeline burst cache
PCI bus with 128-bit graphics accelerator
MPEG compatible
Zoomed Video ready
Microphone and 16-bit stereo sound
20X modular CD-ROM drive
2-way infrared port
Modular floppy drive
Li-Ion battery
Microsoft® Windows® 95 and MS® Plus!
Choice of a Micron Portable Software Solutions Pak
5-year/1-year Micron limited warranty

$1,399
Bus. lease $49/mo.

TransPort XKE

233MHz Intel Pentium processor with MMX technology
32MB EDO RAM
3GB removable hard drive
13.3" TFT XGA display

512KB pipeline burst cache
2 modular expansion bays
2 infrared ports, S-Video, NTSC, game, USB ports
20X CD-ROM drive with AutoPlay™ technology
128-bit, 2MB DRAM graphics
CardBus and Zoomed Video
16-bit stereo sound and microphone
56Kbps fax/modem*
Pick-a-Point™ dual pointing devices
Custom nylon carrying case
Microsoft Windows 95 and MS Plus!
Choice of a Micron Portable Software Solutions Pak
Microsoft Office 97 Small Business Edition
Dragon NaturallySpeaking Personal voice recognition software
5-year/1-year Micron limited warranty

$2,699
Bus. lease $92/mo.

* Maximum transmission speed of up to 56Kbps when downloading data and 33.6Kbps when uploading. However, actual performance is dependent upon numerous factors and observed transfer rates may be less than the maximum potentials.

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Micron Millennia systems. Innovative. Inspired. Inviting.

Ladder of success. Our Micron™ Millennia® Office systems are customized for your business needs. Delivering higher reliability and uncompromising performance, this business PC features the latest Intel processors and operating systems, a high refresh rate and a longer product life. Plus a network interface card and Microsoft's Office '97 Small Business Essential software pak.

Home sweet home. Whether your home computer is for business or for fun, our Millennia Personal line delivers high-tech, high-demand performance. Graphic-intense applications run beautifully, with memory and power to spare. A *PC World* Best Buy, the Millennia Personal includes the Microsoft® Home Essentials software bundle, modem and Zip drive. And if you order a Millennia system now, you'll receive a coupon book worth over $200 of savings on leading Microsoft products. Millennia systems start at just $1,599. Imagine that.

You can also get the Millennia with DVD system for unsurpassed multimedia performance, dazzling DVD technology, incredible sound, and brilliant graphics. All with a smooth, dreamy performance. Perfect for "edutainment" software. Perfect for cutting-edge 3D gaming. Perfect for you.

Millennia 233 Value Bundle

Intel 233MHz Pentium® processor with MMX™ technology
32MB SDRAM
3.2GB Ultra ATA hard drive
15" Micron 500FGx, .28dp monitor (13.7" display)

82430TX chip set
512KB internal cache, 2MB flash BIOS
3.5" floppy drive
24X EIDE variable speed CD-ROM drive
PCI 64-bit 3D video, MPEG, 4MB EDO DRAM
56Kbps data/fax modem*
32 voice wavetable stereo sound
104-key enhanced keyboard
Microsoft IntelliMouse™, USB connections
Stereo speakers
Microsoft Windows® 95 and MS® Plus!
Microsoft Home Essentials
5-year/3-year Micron Power℠ limited warranty

$1,599
Bus. lease **$56/mo.**

Millennia 300 Office Edition

Intel 300MHz Pentium II processor (features MMX technology)
32MB SDRAM
4.0GB Ultra ATA hard drive
15" Micron 500FGx, .28dp monitor (13.7" display)

82440LX chip set
512KB internal cache, 2MB flash BIOS
3.5" floppy
32X EIDE variable speed CD-ROM drive
128-bit AGP 3D video with 4MB SGRAM
10/100 PCI network adapter
32 voice wavetable stereo sound, stereo speakers
104-key enhanced keyboard
Microsoft IntelliMouse, USB connections
Microsoft Windows 95 and MS Plus!
Microsoft Office 97 Small Business Edition
5-year/3-year Micron Power limited warranty

$1,999
Bus. lease **$70/mo.**

* Maximum transmission speed of up to 56Kbps when downloading data and 33.6Kbps when uploading. However, actual performance is dependent upon numerous factors and observed transfer rates may be less than the maximum potentials.

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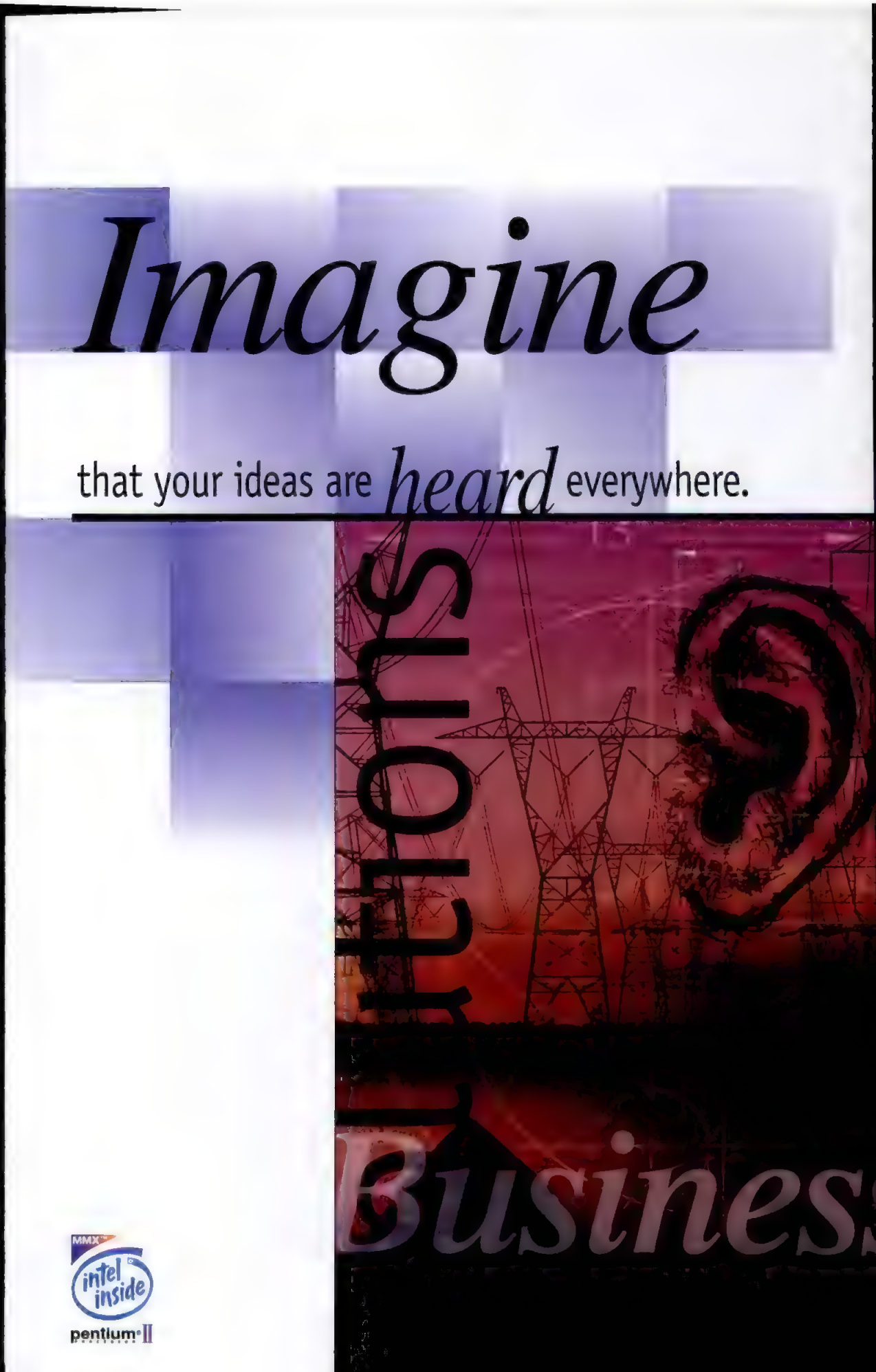
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Total management is now within your reach.

Reach for the stars. Our network-ready ClientPro® desktops give you everything you need in a business PC — at some of the lowest prices ever. The ClientPro runs the gamut from no-nonsense desktop PCs to top-of-the-line, remotely-managed PCs. The ClientPro lowers ownership costs and offers easy network integration — all with remote and local management features. And all with Micron reliability. Our state-of-the-art engineering and management features make this the PC built for success.

One and only. Now, Micron offers Microsoft® Windows NT® standard on all enterprise products, so you'll get a virtually crash-proof, highly secure operating system. Network support's a snap, and your network will be more efficient. Reliable. Powerful. And you can be confident network security won't be compromised.

Safe and sound. Micron™ NetFRAME® servers promise network integrity and manageability. Built from the ground up, you get the hardware and software you want, plus on-site technical support if you need it.

The sky's the limit. We build award-winning workgroup, departmental and enterprise servers — no job is too big or too small. Imagine your company's growth, security and potential. The possibilities are endless.

ClientPro 233

Intel 233MHz Pentium® processor with MMX™ technology
32MB SDRAM
3.2GB SMART Ultra ATA hard drive
15" Micron 500Lx, .28dp color monitor (13.7" display)

512KB pipeline burst cache, DMI 2.0 compliant, 2MB flash BIOS
24X variable speed ATAPI CD-ROM drive
2MB EDO DRAM graphics accelerator
Network adapter with 3Com Remote Wake-up™ capability
Microsoft Windows NT Workstation 4.0
5-year/3-year Micron Power℠ limited warranty

$1,499
Bus. lease **$53/mo.**

NetFRAME MV5001

Intel 233MHz Pentium II processor
64MB ECC SDRAM
4GB Ultra Wide SCSI-3 hard drive
NOS support (1 first-year incident resolution), 7x24

512KB integrated cache in SEC package
9 expansion slots: 6 PCI, 2 ISA, 1 shared ISA/PCI
Dual integrated Symbios Ultra Wide SCSI-3 controller
Integrated Symbios narrow SCSI controller
Intel EtherExpress™ Pro 100 network adapter
20X SCSI-2 CD-ROM drive
I_2O-ready via embedded Intel i960-RD
5 internal, hot-pluggable, hard drive array bays (upgradable to 10)
1 360-watt hot-pluggable power supply standard (upgradable to 3 for added redundancy)
Intel LANDesk® Server Manager 2.8
5-year/3-year Micron Power limited warranty
1-year next-business-day on-site service[1]

$3,799
Bus. lease **$121/mo.**

[1]On-site service for NetFRAME LV2001 and MV5001 servers is provided by Digital Equipment Corporation and is optional.

Business Solutions

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Paint your own canvas.
Mark your own words.
All with the Micron Powerdigm®.

Put your head in the clouds. The award-winning Powerdigm workstation has become a coveted workstation for the most discerning user. The Powerdigm Xsu offers the perfect balance of performance, power and ingenuity. So perfect, *PC Magazine* named it the 1997 Workstation of the Year.

A masterwork station. This PC powerhouse, featuring Micron's own Samurai™ core logic, delivers 64-bit, 66MHz PCI bus performance, and the unbridled power of dual Pentium® II processors. Powerdigm is your quintessential, scalable graphics solution. You'll render high-demand graphics, financial programs or CAD applications without boundaries. And with more than 400MB per second throughput, bottlenecks are a thing of the past. Called "the most exciting PC on the planet" by *PC Magazine* — none of our competitors have even come close. Call us and see why. Imagine a work of art. A stroke of genius. And then imagine the power you'll have.

Powerdigm Xsu

Intel 300MHz Pentium II processor (features MMX™ technology)
64MB ECC SDRAM
4GB Ultra Wide SCSI-3 hard drive
19" Hitachi SuperScan CM751 (18" display) .26dp color monitor

Supports dual processors
Samurai chip set
512KB pipeline burst cache, flash BIOS
Memory upgradable to 1GB ECC SDRAM
Supports IDE Ultra ATA and multiple Ultra Wide SCSI-3 hard drives
32X variable speed SCSI CD-ROM drive
Fire GL 1000 pro 8MB 66MHz PCI Open GL Professional 3D accelerator
3Com Fast EtherLink XL 10/100 PCI network adapter
Wavetable stereo sound with speakers
Microsoft® Windows NT® Workstation
DMI, software and hardware management support
5-year/3-year Micron Power℠ limited warranty

$3,599
Bus. lease **$114/mo.**

Powerdigm Xsu

Dual Intel 333MHz Pentium II processors
128MB ECC SDRAM
4GB Ultra Wide SCSI-3 hard drive
21" Hitachi SuperScan CM801 (20" display) .26dp monitor

Samurai chip set
512KB pipeline burst cache, flash BIOS
Memory upgradable to 1GB ECC SDRAM
Iomega Jaz SCSI drive with 1GB removable cartridge
Supports IDE Ultra ATA and multiple Ultra Wide SCSI-3 hard drives
32X variable speed SCSI CD-ROM drive
Fire GL 4000 15MB 3DRAM/16MB CDRAM
3Com Fast EtherLink XL 10/100 PCI network adapter
Optional support for dual monitors
Wavetable stereo sound with speakers
Microsoft Windows NT Workstation
DMI, software and hardware management support
5-year/3-year Micron Power limited warranty

$6,658
Bus. lease **$211/mo.**

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Portable Solutions

System Configurations

TransPort® XKE

233MHz Intel Pentium processor with MMX technology
32MB EDO RAM
3GB removable hard drive
13.3" TFT XGA display

512KB pipeline burst cache
2 modular expansion bays
2 infrared ports, S-Video, NTSC, game, USB ports
20X CD-ROM drive with AutoPlay™ technology
128-bit, 2MB DRAM graphics
CardBus and Zoomed Video
16-bit stereo sound and microphone
56Kbps fax/modem*
Pick-a-Point™ dual pointing devices
Custom nylon carrying case
Microsoft Windows 95 and MS Plus!
Choice of a Micron Portable Software Solutions Pak
Microsoft Office 97 Small Business Edition
Dragon NaturallySpeaking Personal voice recognition software
5-year/1-year Micron limited warranty

$2,699
Bus. lease **$92/mo.**

TransPort VLX

166MHz Intel Pentium processor with MMX technology
16MB EDO RAM
2.1GB hard drive
12.1 TFT SVGA, 800 x 600 display

256KB L2 pipeline burst cache
PCI bus with 128-bit graphics accelerator
MPEG compatible
Zoomed Video ready
Microphone and 16-bit stereo sound
20X modular CD-ROM drive
2-way infrared port
Modular floppy drive
Li-Ion battery
Microsoft Windows 95 and MS Plus!
Choice of a Micron Portable Software Solutions Pak
5-year/1-year Micron limited warranty

$1,399
Bus. lease **$49/mo.**

TransPort XKE

266MHz Intel Pentium processor with MMX technology
32MB EDO RAM
3GB removable hard drive
13.3" TFT XGA display

512KB pipeline burst cache
2 modular expansion bays
2 infrared ports, S-Video, NTSC, game, USB ports
20X CD-ROM drive with AutoPlay technology
128-bit, 2MB DRAM graphics
CardBus and Zoomed Video
16-bit stereo sound and microphone
56Kbps fax/modem*
Pick-a-Point dual pointing devices
Custom nylon carrying case
Microsoft Windows 95 and MS Plus!
Choice of a Micron Portable Software Solutions Pak
Microsoft Office 97 Small Business Edition
Dragon NaturallySpeaking Personal voice recognition software
5-year/1-year Micron limited warranty

$3,199
Bus. lease **$109/mo.**

TransPort VLX

166MHz Intel Pentium processor with MMX technology
40MB EDO RAM
2.1GB hard drive
12.1 TFT SVGA, 800 x 600 display
56Kbps fax/modem
Microsoft Office Small Business Edition

256KB L2 pipeline burst cache
128-bit graphics accelerator
MPEG compatible
Zoomed Video ready
Microphone and 16-bit stereo sound
20X modular CD-ROM drive
2-way infrared port
Modular floppy drive
Li-Ion battery
Microsoft Windows 95 and MS Plus!
Choice of a Micron Portable Software Solutions Pak
5-year/1-year Micron limited warranty

$1,899
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MMX intel inside pentium® processor

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Performance Desktop Solutions

Millennia® 233 Value Bundle

Intel 233MHz Pentium® processor with MMX™ technology
32MB SDRAM
3.2GB Ultra ATA hard drive
15" Micron 500FGx, .28dp monitor (13.7" display)

82430TX chip set
512KB internal cache, 2MB flash BIOS
3.5" floppy drive
24X EIDE variable speed CD-ROM drive
PCI 64-bit 3D video, MPEG, 4MB EDO DRAM
56Kbps data/fax modem*
32 voice wavetable stereo sound
104-key enhanced keyboard
Microsoft® IntelliMouse™, USB connections
Stereo speakers
Microsoft Windows® 95 and MS® Plus!
Microsoft Home Essentials
5-year/3-year Micron Power℠ limited warranty

$1,599
Bus. lease **$56/mo.**

Millennia 300 Personal Edition

Intel 300MHz Pentium II processor (features MMX technology)
32MB SDRAM
4.0GB Ultra ATA hard drive
15" Micron 500FGx, .28dp monitor (13.7" display)

82440LX chip set
512KB internal cache, 2MB flash BIOS
3.5" floppy
32X EIDE variable speed CD-ROM drive
128-bit AGP 3D video with 4MB SGRAM
32 voice wavetable stereo sound, stereo speakers
56Kbps data/fax modem*
104-key enhanced keyboard
Microsoft IntelliMouse, USB connections
Microsoft Windows 95 and MS Plus!
Microsoft Home Essentials
5-year/3-year Micron Power limited warranty

$2,099
Bus. lease **$73/mo.**

Millennia 300 Office Edition

Intel 300MHz Pentium II processor (features MMX technology)
32MB SDRAM
4.0GB Ultra ATA hard drive
15" Micron 500FGx, .28dp monitor (13.7" display)

82440LX chip set
512KB internal cache, 2MB flash BIOS
3.5" floppy
32X EIDE variable speed CD-ROM drive
128-bit AGP 3D video with 4MB SGRAM
10/100 PCI network adapter
32 voice wavetable stereo sound, stereo speakers
104-key enhanced keyboard
Microsoft IntelliMouse, USB connections
Microsoft Windows 95 and MS Plus!
Microsoft Office 97 Small Business Edition
5-year/3-year Micron Power limited warranty

$1,999
Bus. lease **$70/mo.**

Millennia 333 Personal DVD Edition

Intel 333MHz Pentium II processor (features MMX technology)
64MB SDRAM
8.4GB Ultra ATA hard drive
19" Hitachi Superscan CM751 monitor (18.0" display)

82440LX chip set
512KB internal cache, 2MB flash BIOS
Integrated 100MB Iomega Zip drive
3.5" floppy
DVD-ROM drive and PCI decoder card
128-bit AGP 3D video with 4MB SGRAM
AWE 64 ISA sound card
Stereo speakers with subwoofer
56Kbps x2 data/fax modem*
104-key enhanced keyboard
Microsoft IntelliMouse, USB connections
Microsoft Windows 95 and MS Plus!
Microsoft Home Essentials
5-year/3-year Micron Power limited warranty

$2,999
Bus. lease **$102/mo.**

* Maximum transmission speed of up to 56Kbps when downloading data and 33.6Kbps when uploading. However, actual performance is dependent upon numerous factors and observed transfer rates may be less than the maximum potentials.

Business Solutions

NetFRAME® LV2001

Intel 233MHz Pentium II processor
32MB ECC SDRAM
4GB Ultra Wide SCSI-3 hard drive
NOS support
(1 first-year incident resolution), 7x24

512KB integrated cache in SEC package
ECC SDRAM option (4 DIMM slots)
5 expansion slots: 4PCI, 1 ISA
Integrated Adaptec PCI Ultra Wide SCSI-3 controller
Intel EtherExpress™ Pro 100 network adapter
20X SCSI-2 CD-ROM drive
Upgradable to 36GB storage
Intel LANDesk® Server Manager 2.8
5-year/3-year Micron Power limited warranty
1-year next-business-day on-site service[1]

$2,399
Bus. lease **$84/mo.**

NetFRAME MV5001

Intel 233MHz Pentium II processor
64MB ECC SDRAM
4GB Ultra Wide SCSI-3 hard drive
NOS support
(1 first-year incident resolution), 7x24

512KB integrated cache in SEC package
9 expansion slots: 6 PCI, 2 ISA, 1 shared ISA/PCI
Dual integrated Symbios Ultra Wide SCSI-3 controller
Integrated Symbios narrow SCSI controller
Intel EtherExpress Pro 100 network adapter
20X SCSI-2 CD-ROM drive
I_2O-ready via embedded Intel i960-RD
5 internal, hot-pluggable, hard drive array bays (upgradable to 10)
1 360-watt hot-pluggable power supply standard (upgradable to 3 for added redundancy)
Intel LANDesk Server Manager 2.8
5-year/3-year Micron Power℠ limited warranty
1-year next-business-day on-site service[1]

$3,799
Bus. lease **$121/mo.**

ClientPro® 166 Base

Intel 166MHz Pentium processor with MMX technology

Microsoft Windows NT Workstation 4.0
5-year/3-year Micron Power limited warranty

Monitor not included

Starting at
$999

ClientPro 233

Intel 233MHz Pentium processor with MMX technology
32MB SDRAM
3.2GB SMART Ultra ATA hard drive
15" Micron 500Lx, .28dp color monitor (13.7" display)

512KB pipeline burst cache, DMI 2.0 compliant, 2MB flash BIOS
24X variable speed ATAPI CD-ROM drive
2MB EDO DRAM graphics accelerator
Network adapter with 3Com Remote Wake-up™ capability
Microsoft Windows NT Workstation 4.0
5-year/3-year Micron Power limited warranty

$1,499
Bus. lease **$53/mo.**

ClientPro 266

Intel 266MHz Pentium II processor (features MMX technology)
64MB SDRAM
3.2GB SMART Ultra ATA hard drive
17" Micron 700FGx, .26dp (16" display)

512KB internal L2 secondary cache, DMI 2.0 compliant, 2MB flash BIOS
24X variable speed ATAPI CD-ROM drive
4MB AGP 3D video
Network adapter with 3Com Remote Wake-up capability
Microsoft Windows NT Workstation 4.0
5-year/3-year Micron Power limited warranty

$2,049
Bus. lease **$72/mo.**

[1]On-site service for NetFRAME LV2001 and MV5001 servers is provided by Digital Equipment Corporation and is optional.

MICRON POWER™ WARRANTY

5 year limited warranty on microprocessor and main memory
3 year limited parts only system warranty (1 year for TransPort systems)
1-, 2- or 3-year optional on site service agreement for Micron desktop and server systems
30 days of free Micron supplied software support for Micron desktop systems, 3 additional release operating system support releases included for Micron server systems
30-day money back policy
24 hour technical support

The foregoing is subject to and qualified by Micron's standard limited warranties and terms and conditions of sale. Terms and conditions of sale may vary for specific configurations. Copies of the limited warranties may be obtained on our Web site or by calling Micron.

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Toll-free from Canada: 800-708-1758
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COLOR FLATBED SCANNERS

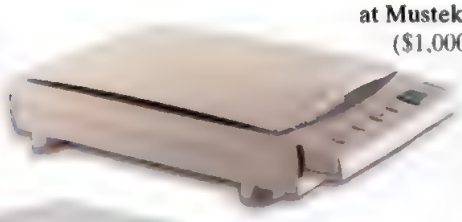
Images at Your Fingertips

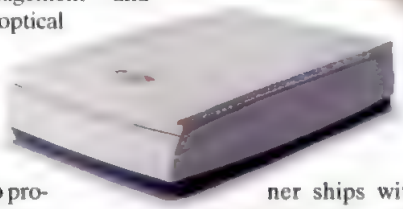
If you require a professional-quality image scanner that's easy to use and moderately priced, look no further than these new units, which are designed to meet the needs of business and small-office users.

The latest scanner from Visioneer (800-787-7007, *www.visioneer.com*) is the $249 **PaperPort OneTouch**, a 36-bit scanner that offers 600- by 1,200-dpi optical resolution. The OneTouch features four buttons built into its outer shell, and each button launches a specific function (Scan, Copy, Fax, and Stop). It also has a fifth user-customizable button that can be programmed for multistep activities, such as scanning photos and posting them on the Web or automatically attaching images to e-mail messages. Bundled software includes Visioneer's PaperPort for document management and ProOCR 100 for optical character recognition. PictureWorks PhotoEnhancer and Visioneer's Web Publisher are also provided with the scanner.

New from Mustek (800-468-7835, *www.mustek.com*) are three color flatbed scanners for the SOHO market. The **Plug-n-Scan 1200 III EP** ($200 street) is a compact scanner featuring 36-bit color depth and 600- by 1,200-dpi resolution. The scanner ships with Xerox TextBridge Classic OCR and easily attaches to your PC via an ECP or EPP parallel port. Mustek's **Paragon 1200 III SP** ($250 street) also features 36-bit color depth with 600- by 1,200-dpi resolution, but it is more compact than its sibling and runs faster thanks to its SCSI interface. Like the Plug-n-Scan, the Paragon ships with Xerox TextBridge OCR.

RECAP In our First Looks roundup of seven value flatbed scanners (November 4, 1997), we awarded our Editors' Choice to the Visioneer PaperPort 6000.





36-BIT DAZZLE: *New scanners from Visioneer (above) and Mustek.*

If you need to scan large-format media, then have a look at Mustek's **Paragon 1200 A3 Pro** ($1,000 street price), which is designed for scanning documents of up to 11.7 by 17 inches in size. The A3 Pro offers 36-bit color depth, 600- by 1,200-dpi optical resolution, and a SCSI-2 interface; it also ships with OCR software.

Plustek USA (800-685-8088, *www.plustek.com*) is now shipping the $199 **OpticPro 9636T**, which can scan slides and negatives as well as standard paper photos and documents. It has a 600- by 1,200-dpi optical resolution, 36-bit color depth, and a scanning capacity of up to 8.5 by 11.7 inches. Bundled software includes Xerox Textbridge OCR, Micrografx PicturePublisher 7.0, and American Greetings CreataCard.
—*Emily Cohen*

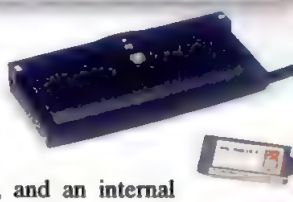
MOBILE ACCESSORIES

Gadgets for Travelers

Being a mobile professional isn't easy. You're on the go all the time, and there are meetings to attend, calls to return, and schedules to adjust and readjust. Fortunately, a growing number of tools are available to help you get where you want to go and stay connected while traveling.

For keeping your bearings no matter where you wander, Etak (888-275-9627, *www.etak.com*) sells the $299.95 **SkyMap Pro**, a PC Card GPS receiver and software bundle that lets you pinpoint your current location, find destinations, and identify the best routes on the fly. Its graphical interface links you to an extensive map database that shows city streets, country roads and highways, and even readouts of your current heading, speed, altitude, and distance from your destination. Other features include a searchable database of more than 500,000 points of interest, detailed diagrams of 50 major airports, and a contact database that stores such personal information as phone numbers and e-mail addresses.

To keep the power running when you're in limbo between Point A and Point B, Mobility Electronics (800-311-3274, *www.mobilityelectronics.com*) offers the **Easi-Power In Air/Auto Charger**. Available in two versions—45-watt ($80 street price) and 75-watt ($100 street price)—this 7-ounce unit lets you draw power for your notebook from a car's cigarette lighter or an in-seat power supply on an airplane, and it even lets you charge the battery while using the PC. Power protection and safety features include a user-replaceable fuse, a voltage-input filter, an over-current shutdown feature, and an internal thermal cutoff.



ON THE GO: *The SkyMap Pro (above and inset) and the Universal Port Replicator.*

Mobility Electronics also offers the **Universal Port Replicator** ($200 street). This device plugs into your PC Card slot and replicates parallel, serial, keyboard and mouse ports; it also adds a DC-in power socket. Another model, priced at $280 (street), provides Ethernet connectivity as well.—*Roderick A. Beltran*

Relieving Mouse-Related Wrist Strain

The folks at MedExcel (800-335-7297, *www.powerpaw.com*) have endeavored to build a better mousepad: the **Power Paw** ($19.95 direct). According to the Power Paw's inventors, traditional gel-filled pads still exert pressure on the soft underside of the wrist, which could lead to carpal-tunnel syndrome. This unique gel-filled pad supports the bones on either side of your wrist. You can also place it beneath your elbow so your forearm "floats." The Paw can even be chilled to provide cooling comfort.—*Jamie M. Bsales*

BOTTOM-LEFT PHOTO BY JEFFREY KLEIN

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— Director of PointCast Networks, PointCast, Inc.

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- Intel 333 MHz Pentium II Processor
- 512KB Cache, Up to 2 CPUs
- 64MB SDRAM Exp. to 512MB
- Slots: (5) PCI, (3) ISA, (1) AGP
- 9GB 10,000 RPM WLVD (5.0ms) Removable
- Adaptec 2940UW SCSI LVD
- Diamond Fire GL 8MB Video
- Sony 32x CD-ROM, Keyboard, Floppy, Mouse
- Tower Chassis 300 Watt Power Supply

$3023

16MB Symmetric: $3664

32MB Symmetric MX, Open GL Card: $4466

STA DUAL PENTIUM II 300 MHz

- 1 Intel Pentium II 300 MHz Processor
- 512KB Cache, Up to 2 CPUs
- 64MB of SDRAM Exp. to 512MB ECC Supported
- Slots: (4) PCI, (3) ISA, (1) AGP
- 9GB 7200RPM IDE
- #9 Revolution 8MB Video AGP
- Sony 32x CD-ROM
- Keyboard, Floppy, Mouse
- Mid Tower Case

$1992

4.3 GB Ultra Wide SCSI Solution: $1992

STA ALPHA 533 MHz

- Alpha 533 MHz CPU
- 64MB SDRAM
- 9GB 10,000 RPM WLVD (5.0ms)
- Adaptec 2940 UW LVD
- Matrox Millenium II 8MB
- Sony 32x CD-ROM
- Keyboard, Floppy, Mouse
- Full Tower Case

$3375

STA PENTIUM II 233 MHz

- 1 Intel Pentium II 233 MHz CPU
- 32MB of SD RAM Expandable to 256MB
- 2.1 GB EIDE Ultra 33 HD 9.5ms
- #9 334 4MB Video SGRAM AGP
- Integrated Sound
- 3-D SS speakers
- Sony 32x CD-ROM
- Keyboard, Floppy, Mouse
- Desktop Case

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Landesk Option Available

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SAMPLE SERVERS – ALL SYSTEMS CUSTOM BUILT

STF QUAD PRO

- 1 Intel Pentium Pro Processor
- 512K Cache, Up to 4 CPUs
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- Slots (6) PCI; (4) EISA
- 9GB 10,000 RPM WUVD (5.0ms) Removable
- Adaptec 2940 UW KVD
- Number Nine 334 4MB Video
- Intel 10/100 Ethernet
- Sony 32x CD-ROM
- Keyboard, Floppy, Mouse
- 12 Bay Power Chassis, 600 Watt Red. Power

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Rackmount & RAID 5 Options Available

STF DUAL PENTIUM II 333 MHz

- Intel 333MHz Pentium II Processor
- 512K Cache Up to 2 CPUs
- 64MB of SDRAM Exp. to 512 MB
- Slots: (4) PCI, (1) ISA, (1) AGP
- IBM 18GB 7200 RPM UW, 7ms
- Integrated Adaptec 2940 UW SCSI
- Integrated Intel 10/100 Ethernet
- Integrated 1 MB Video
- Sony 32x CD-ROM
- Keyboard, Floppy, Mouse
- Intel Server Manager
- Tower Chassis 300 Watt Power Supply

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STF PENTIUM II 333 MHz RAID 5

- 1 Intel Pentium II 333 MHz Processor
- 512KB Cache Up to 2 CPUs
- 64MB SDRAM Exp. to 512MB
- Slots: (5) PCI (3) ISA, (1) AGP
- Q: (3) 4GB Ultra Wide Removable HD 8.5ms
- RAID 5 Controller, 3 Channels with 16MB Cache
- Intel 10/100 Ethernet
- Number Nine 334 4MB Video
- Sony 32x CD-ROM
- Keyboard, Floppy, Mouse
- 12 Bay Tower, 300 Watt Redundant Power Supply

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SAMPLE RAID 5 SUBSYSTEMS – ALL SYSTEMS CUSTOM BUILT

STC 2000 RAID 5

- 2-Channel RAID UW Controller
- 8 Hot-swappable Drive Bays
- 2-300 Watt N+1 Red. Power Supplies
- 32 MB Cache
  - Internal temperature status
  - Power supply status
  - Cooling fan status
  - Visual and audible alarm

18GB Solution
- Q: (4) 4.5GB 10,000RPM UW HD: $6795

27GB Solution
- Q: (3) 9.1GB 7200RPM UW HD: $6820

54GB Solution
- Q: (3) 18GB 7200RPM UW HD: $9125

FTC2000 20 BAY SINGLE

- 4 Channel RAID 5 UW Controllers
- 20 Hot Swappable Drive Bays
- 8 - 230 Watt Hot Redund. Power Supplies
- 32MB of Cache
  - Internal temperature status
  - Power supply status
  - Cooling fan status
  - Visual and audible alarm

144GB Solution
- Q: (8) 18GB 7200RPM UW HD: $20,285

72GB Solution
- Q: (8) 9.1GB 10,000RPM UW HD: $15,910

32GB Solution
- Q: (8) 4.3GB 72000RPM UW HD: $12,995

STC 2000 20 BAY

- Active/Active Controllers
- Q: (2) 4 Channel RAID 5 UW Controllers
- 8 - 230 Watt Hot Redund. Power Supplies
- 128MB of Cache
  - Internal temperature status
  - Power supply status
  - Cooling fan status
  - Visual and audible alarm

144GB Solution
- Q: (8) 18GB 7200RPM UW HD: $25,560

72GB Solution
- Q: (8) 9.1GB 10,000RPM UW HD: $21,359

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- Q: (8) 4.3GB 72000RPM UW HD: $17,695

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PROGRAM ANALYZERS

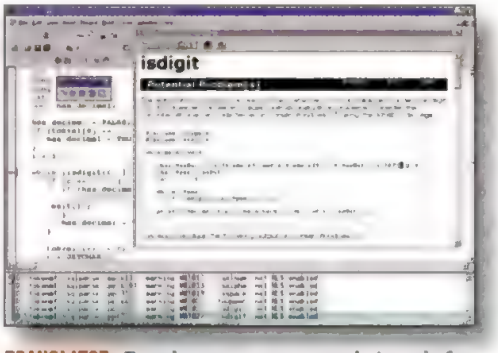
Developers' Heaven

Analyzing and pinpointing errors in Internet applications can be a frustrating and time-consuming undertaking. These four analysis tools can help save time and your sanity by quickly investigating and detecting troublesome code.

From the KL Group (800-663-4723, *www.klg.com*) comes the $499 **JProbe Profiler,** which identifies Java performance bottlenecks using a hierarchical profiler that conducts in-depth code analysis. Using the standard Sun virtual machine (VM), JProbe eliminates performance-tuning guesswork and allows Java run-time performance to be accurately measured and explored in real time. You also get a Call Graph interface that shows the calling relationships among different Java methods.

ProtoSpeed, from Progress Software (800-999-4599, *protospeed.progress.com*), is a $995 program that lets developers debug distributed objects for Internet applications. Supporting all Internet protocols, ProtoSpeed enables the users of Visual Basic or Visual J++ to debug protocol interactions among components, regardless of the language. You can also use ProtoSpeed to debug Java applets and applications running in both the Microsoft and Sun Java VMs without source code.

SourceAgain, from Ahpah Software (650-960-2472, *www.ahpah.com*), is a $99 decompiler that produces source code from Java byte code equivalent to the original. SourceAgain lets developers debug Java components using a technology that adds debugging information to the decompiled source code. It runs on Windows 95 and NT and most flavors of Unix.



TRANSLATOR: *Developers can prepare their code for multilingual markers using Global Checker.*

Shipping from Uniscape (650-596-1430, *www.uni-scape.com*) is **Global Checker,** a utility that helps developers ready their code for multilingual markets. Integrated into MS Visual C++ 5.0 and run from the command line, Global Checker scans C and C++ type source and then identifies and reports areas of noncompliance under National Language Support standards. It can also report multibyte function or string manipulation problems. It then suggests solutions through an online help system and the HTML-based Global Primer.

There are three versions of Global Checker: the $399 Global Checker QA, the $699 Global Checker Developer, and the $1,500 Global Checker Enterprise.—*Roderick A. Beltran*

Data in Transition

As companies move away from legacy systems, they're relying more on mission-critical applications located on their PCs. But moving information among systems has traditionally been a headache for large and small organizations alike. SmartDB Corp.'s **SmartDB Workbench 3.5** (888-243-8762, *www.smartdb.com*) could change that.

This middleware data-integration software eliminates the need for businesses to do their own application-integration programming. Through the use of prebuilt templates, SmartDB Workbench facilitates data migration and integration among Oracle database management system (DBMS) applications.

The product creates data links automatically, enabling companies to move data directly among live, disparate applications. Users can easily change data definitions for faster prototyping and testing. Workbench is best suited for organizations that don't need constant real-time data transfer but can operate efficiently by transferring data on a daily or weekly basis.—*Carol Mangis*

INTERFACE BUILDERS

Build It with Style

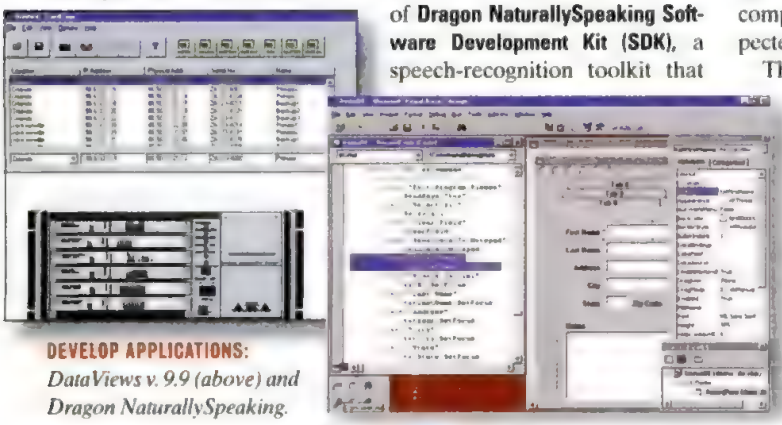
If the time you spend building user interfaces and Internet applications seems endless, these three development tools should be able to help.

DataViews v 9.9 is a real-time visualization tool from DataViews Corp. (800-732-3200, *www.dvcorp.com*). With pricing starting at $11,700, DataViews lets you build interfaces to depict, analyze, and regulate industrial or scientific processes, such as circuit boards and interactive maps. The latest DataViews upgrade provides native Windows controls for DV-Draw, a point-and-click interactive drawing editor. The Web-DataViews Web component supports both Netscape Plug-In and Microsoft Active-X technology.

Dragon Systems (617-965-5200, *www.naturallyspeaking.com*) has announced the public beta release of **Dragon NaturallySpeaking Software Development Kit (SDK),** a speech-recognition toolkit that encapsulates Dragon's continuous-speech technology into ActiveX components. The product is expected to go final by late May.

The Dragon SDK lets developers integrate continuous-speech-recognition features into their own programs using Microsoft Visual Basic, Microsoft Visual C++, Borland Delphi, and other ActiveX-standard environments.

Interactive Objects (425-869-6338, *www.iobjects.com*) recently released **Visual Gateway Interface (VGI),** a software development tool that enables programmers to write applications for Windows NT Web servers without writing individual interfaces. VGI downloads as an object within the toolboxes of all popular visual environments, including Delphi, Visual Basic, Visual C++, and Visual FoxPro. VGI also offers a debugger that pinpoints problems and suggests fixes. Developers can download VGI from Interactive Objects' Web site for an introductory price of $99, or they can evaluate it for free for 30 days. —*Emily Cohen*



DEVELOP APPLICATIONS: *DataViews v. 9.9 (above) and Dragon NaturallySpeaking.*

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intel inside pentium

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EDITORS' CHOICE

The AMS Tech Rodéo 5030ECX won Editors' Choice in a test of 21 top-of-the-line notebook computers. The Rodéo 5030ECX finished first in the BAPCo SYSmark32 suite, which tests real-world business applications and came in second in the Intel Media Benchmark suite, which tests multimedia performance.

Computer Reseller News February 2, 1998

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5000ECX	233MHz Pentium® Processor	3.1GB HDD	32/128 MB RAM	14.1" XGA TFT	56K Modem	20X CD-ROM	$3595.00
3040ECX	266MHz Pentium® Processor	4.0GB HDD	64/128 MB RAM	14.1" XGA TFT	56K Modem	24X CD-ROM	$3895.00
3035CX	266MHz Pentium® Processor	3.1GB HDD	32/128 MB RAM	13.3" XGA TFT	56K Modem	24X CD-ROM	$2995.00
3030ECX	233MHz Pentium® Processor	4.0GB HDD	64/128 MB RAM	14.1" XGA TFT	56K Modem	20X CD-ROM	$3795.00
3020ECX	233MHz Pentium® Processor	3.1GB HDD	64/128 MB RAM	14.1" XGA TFT	56K Modem	20X CD-ROM	$3695.00
3015ECX	233MHz Pentium® Processor	2.1GB HDD	32/128 MB RAM	14.1" XGA TFT	56K Modem	20X CD-ROM	$3395.00

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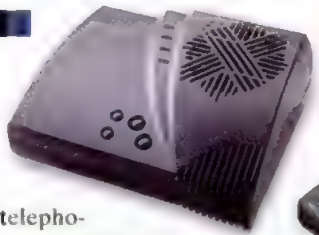
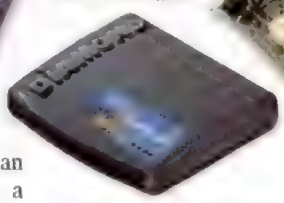
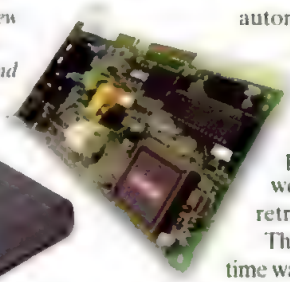
MODEMS

A United Front







SPEED SURFERS: *New 56K modems from 3Com and Diamond (below and right).*

The ITU has released its long-awaited 56K modem standard—V.90—which effectively ends the competition between x2 and K56flex. The presence of a single standard will free you from choosing between competing standards, and it may also spur ISPs who have been holding out to adopt 56K.

Diamond Multimedia Systems (800-468-5846, *www.diamondmm.com*) is one of the first vendors to ship V.90 modems. The $99.95 **SupraExpress 56i** is a basic internal PC fax modem. The external $129.95 **SupraExpress 56e** fax modem features a new design and a smaller footprint. If you need telephony capabilities, try the $119.95 **SupraExpress 56iSp**, an internal modem that offers a speakerphone.

An added bonus for SupraExpress owners is the ability to download a free copy of Diamond's Shotgun software. Shotgun allows you to hook up two modems over standard POTS lines to get connection speeds of up to 112 Kbps. If you have a second data-only phone line, Diamond is offering the $199.95 **SupraSonic II**, which features two V.90 modems on a single ISA card.

Industry leader 3Com (888-492-6856, *www.3com.com*) is also one of the first out of the gate with an entire line of V.90-compliant products. The 3Com line will include the **56K FaxModem** ($160 street internal, $180 street external), the **56K WinModem** ($100 street internal only), and the **56K Voice FaxModem** ($180 street internal, $250 street external).

The 56K WinModem features automatic installation when you hook it up to your computer, while the 56K Voice FaxModem offers a full-duplex speakerphone as well as remote voice mail retrieval.

These units come with lifetime warranties and simultaneous support for both the V.90 and x2 standards. Also included with each modem is a CD-ROM with Internet software, including Microsoft Internet Explorer 4.0, Microsystems Software's CyberPatrol, and PointCast.

E-Tech Research (510-438-6700, *www.e-tech.com*) is also joining the V.90 release. Its $129 modem **CyberBullet V.90** features voice capabilities and a full-duplex speakerphone.—*Michael N. Rusignuolo*

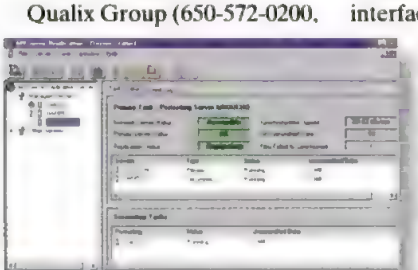
DATA MIRRORING

A Copy for Safekeeping

Data-mirroring software lets you replicate mission-critical data to one or more backup servers in real time to insure against server failure. If a server goes down, the software seamlessly routes you to your backup. Although this process is especially critical for transaction servers, it's a sound backup idea for any data you need to access constantly.

Qualix Group (650-572-0200, *www.qualix.com*) is releasing **Octopus DataStar 3.1**, the newest version of its real-time mirroring software ($1,199 for one system with unlimited users). Though it runs primarily on Microsoft Windows NT or NT Workstation 3.51 or higher, DataStar can also send or receive data from Windows 95 nodes. The software requires just 5MB of space on the target and source machines as well as the necessary disk space to store the program on the target machine. Octopus minimizes network usage by mirroring only file changes rather than entire files.

The software's drag-and-drop interface lets you select the files, directories, or disks you wish to mirror. Microsoft's RPC interface is used to log changes at both the source and target machine to ensure robust protection; since data changes are captured and updated without caching, the changes are mirrored immediately. Version 3.1 also includes new support for shared-disk capability to ensure that the server won't be a single point of failure (SPOF).



MIRROR IMAGE: *ARCserve Replication for Windows NT, from Computer Associates.*

Computer Associates' new $29.95 **ARCserve Replication for Windows NT** (800-424-3936, *www.cai.com/cheyenne*) is the first data-mirroring product in the company's line of storage-management products. ARCserve Replication works on Windows NT Server or Workstation 4.x or higher running service pack 3. The software requires 10MB on each source or recipient machine, and the administrator can set the disk space for file replication.

ARCserve Replication is the first data replication product to offer Total Transactional Integrity. This ensures that only completed transactions are replicated, eliminating the risk of data corruption due to mirroring incomplete transactions. ARCserve also has the unique ability to allow reconfiguration of mirroring tasks while the system is active.—*MNR*

Flexible Sales

Channelware 2.0, from Nortel's Channelware business unit (888-439-0000, *www.channelware.com*), gives software publishers the opportunity to activate per-use and trial versions of their programs, which are distributable via the Internet or CD-ROM.

The Channelware Converter, which is free to software producers, creates a secure version of an application that won't run without an electronic "key" created by the $25,000 Channelware Activation Server. A company can then distribute this secure program freely. When a user runs the program, it connects with the Activation Server at the software company. The Server requests payment and registration information and then unlocks the program. The Web-accessible keys permit flexible trial, lease, or—new in Version 2.0—purchase rights for a software product. Channelware 2.0 is available for Microsoft Windows 95 software titles.—*Stephanie Lindenbaum*

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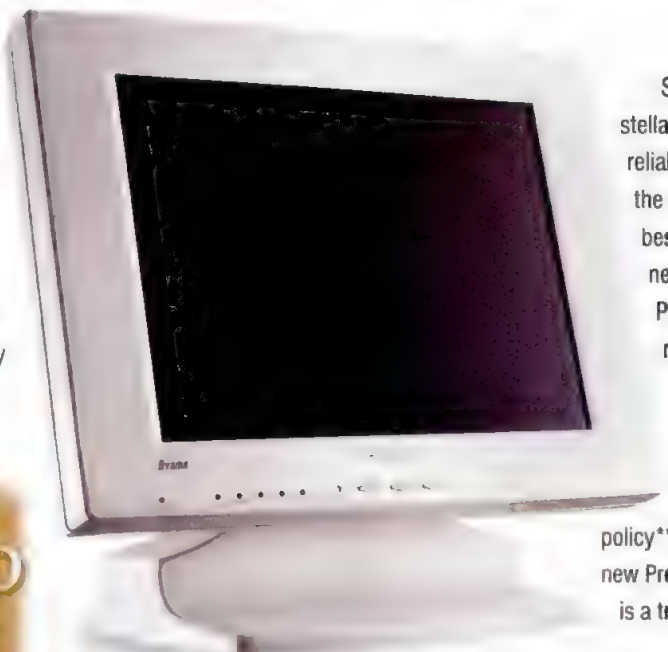

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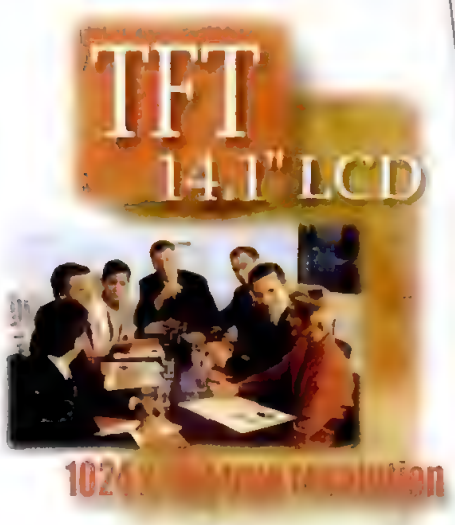

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Power Supply: Built-in/External	Built-in	External	Built-in	External	External
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First Looks

INSIDE

PALM COMMUNICATION:

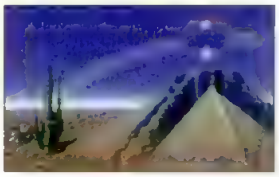
With 2MB of RAM and an IR transceiver, the 3Com Palm III is the next step up from the PalmPilot Pro. See *page 7*.

STAY HOME:

With Philips' DVX8000 Multimedia Home Theater and the Projectavision Digital Home Theater, you can open your own box office. See *pages 8 and 9*.

NO SPECIAL GLASSES:

MetaCreations' Bryce 3D and CrystalGraphics' Crystal 3D Impact! Pro will breathe new life into your graphics. See *page 10* for the review.



More Products Reviewed . . .

OmniForm 3.0 56
Lexmark 5700 Color Jetprinter 68
FastTrack Schedule 5.02 68
Picture Publisher 8 73
Diva T/A ISDN Modem 76
KeyText 1.0 76

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PC MAGAZINE ONLINE

The Pentium II Goes Mobile

Intel brings its flagship processor to the notebook platform, and PC Labs tests the first seven 266-MHz systems from the market leaders.

By Carol Venezia

The moment that MIPS-starved road warriors have been waiting for has finally arrived. On April 2, Intel introduced its first Pentium II processor in a low-power, compact package made specifically for notebook PCs. The first iterations of this processor will come in both 233- and 266-MHz flavors, packaged either as mobile modules or minicartridges to fit all types of notebooks. Intel has also introduced new core logic to go along with the processor: the 440BX.

Even though the mobile Pentium II's clock speeds are identical to those of the two newest mobile Pentiums—popularly known by the code-name of Tillamook—the mobile Pentium II processor ups the ante over Intel's mobile Pentium CPU in several key ways. First, like its desktop brethren, the mobile PII supports a dual-independent bus architecture. So even though it still interfaces to system memory at 66 MHz, a separate, backside bus talks to 512K of L2 cache at half the processor's clock speed (or 133 MHz for the 266-MHz part; Tillamook maintained a 66-MHz link to L2 cache). This bus boost partially explains the results of our $CPUmark_{32}$ tests: On the average, the Pentium II notebooks in this roundup posted scores that were as much as a third higher than same-speed Tillamooks.

Second, the Pentium II is simply a much more complex CPU. Unlike the Pentium, it supports dynamic execution. It also ups the transistor count to 7.5 million from the Pentium's 4.5 million. Both, however, are manufactured on a 0.25-micron process that uses CMOS and voltage-reduction technology to enable lower-power, higher-density CPUs.

Core and I/O voltages do differ, though. Although the 266-MHz mobile Pentium operates at 2V internally and 2.5V externally, the same-speed mobile Pentium II runs at 1.7V internally and 1.8V externally. This partly explains why you don't really sacrifice much battery life with the mobile PII (in spite of it being a much more complex die). In fact, our testing showed that the average 266-MHz Tillamook notebook covered in our last roundup (February 10, 1998) lasted 3 hours on our Bat-

PHOTOGRAPHY BY THOM O'CONNOR

teryMark test; the average battery life for these PIIs was also about 2 hours and 45 minutes.

MORE POWER AND AGP

For our first look at Pentium II notebooks, we rounded up seven systems: One from Compaq and two each from Dell, IBM, and Toshiba. All are powered by the 266-MHz CPU, as the faster processor is expected to generate more interest.

The Pentium II is all about power, so you're probably wondering if these notebooks deliver that power. Although there were gains across the board, the most significant and telling results were seen on our Winstone benchmark test. As compared to 266-MHz Tillamook units from our last roundup, these Pentium IIs delivered Winstone scores that were, on average, 22 percent higher.

We also saw big gains from some systems on our Graphics WinMark test. The top score was posted by the Compaq Armada 7800, the first notebook available with AGP graphics. Powered by S3's ViRGE/MX AGP accelerator—and a Compaq-designed core-logic chip set—the Armada garnered a Graphics WinMark score of 116. This is only slightly better than the second-highest score (posted by the Toshiba Tecra), but it's 46 percent higher than the top scorers from our Tillamook roundup.

THE BOTTOM LINE

We anticipate the Pentium II will proliferate very quickly across the mobile platform, given the variety of machines that we tested for this roundup (we looked at everything from value systems to lightweights and high-end desktop replacements). If our test machines are any indicator, you shouldn't have a difficult time finding a Pentium II notebook to suit your computing needs as well as your budget.

Speaking of budgets, if yours is tight, one of our Editors' Choices—the $3,199 Dell Inspiron 3200 D266XT—is an outstanding bargain, and it doesn't cut back on key components. But if money is not an object, you should look to our high-end Editors' Choice, the Toshiba Tecra 780DVD.

Compaq Computer Corp.

Compaq Armada 7800

If you need every last drop of raw computing horsepower that you can get in a notebook, consider the top performer here: the Compaq Armada 7800 ($5,400 street). The Armada falls a bit short of the competition in terms of battery life and some hardware-related features, but it is an exceptional portable for its target audience of power users (particularly in the financial and CAD fields) who require fast graphics.

The big story behind this Armada is power. This machine—swathed in a sleek new carbon-colored case—features not only a Compaq-designed core-logic chip set (the Armada is the only unit here that doesn't use Intel's 440BX) but also the notebook industry's first implementation of AGP graphics. Outfitted with an S3 ViRGE/MX AGP graph-

BENCHMARK TESTS

266-MHz Pentium II Notebooks

The performance leader here was the Compaq Armada 7800. It brings a never-before-seen feature to the notebook space: AGP graphics, powered by S3's ViRGE/MX accelerator. Putting graphics on a dedicated 66-MHz bus—and adding 4MB of 100-MHz SGRAM—helped to push this machine slightly ahead of the others on both our Winstone and Graphics WinMark tests.

The BatteryMark champion for this roundup was the IBM ThinkPad 770ED, which clocked a time of 3 hours 46 minutes. And that's no small feat for this machine: Not only does it have the largest display here, at 14.1 inches, but one of the biggest hard disks as well, at 8.1GB.

Bold type denotes first place.	ZD Business Winstone 98 Score	ZD Business Graphics WinMark 98 Score	ZD Business Disk WinMark 98 Thousands of bytes/sec	ZD CPUmark32 Score	ZD CD-ROM WinMark 98 Thousands of bytes/sec	ZD BatteryMark 2.0 Hours minutes
Compaq Armada 7800	**20.3**	**116**	1,010	**693**	903	2:12
Dell Inspiron 3200 D266XT	18.1	86	920	681	**1,400**	2:36
Dell Latitude CPi D266XT	18.9	86	924	687	976	2:01
IBM ThinkPad 600	17.8	79	848	684	1,380	3:12
IBM ThinkPad 770ED	19.5	102	1,000	685	1,140	**3:46**
Toshiba Satellite Pro 490XCDT	19.2	100	922	666	1,070	2:22
Toshiba Tecra 780DVD	19.9	107	**1,050**	674	931	3:02
	BETTER ▶	BETTER ▶	BETTER ▶	BETTER ▶	BETTER ▶	BETTER ▶

Editors' Choice

- High End: Toshiba Tecra 780DVD
- Value: Dell Inspiron 3200 D266XT

If our inaugural look at Intel's new mobile Pentium II processor proved one thing, it's that regardless of your computing needs or budget, there's a PII notebook out there for you. Our two Editors' Choices in this roundup represent both ends of the portables spectrum. On the value side of the equation, our Editors' Choice is the Dell Inspiron 3200 D266XT ($3,199 direct).

Dell's Inspiron may carry an outstandingly low and affordable price, but it certainly doesn't low-ball you on components. To the 266-MHz Pentium II processor, Dell adds a 13.3-inch XGA display, 64MB of synchronous DRAM (expandable to 144MB), a 3.9GB hard disk, and a 24X max CD-ROM drive. With a travel weight of just over 7 pounds, this notebook won't weigh you down. And with a worst-case-scenario battery life of 2:36 (and support for a second battery), you won't come up short when you're away from an AC outlet. Dell also adds Microsoft Office Small Business Edition—with a special power-friendly version of Microsoft Word—to complete this attractive package.

At the high end, our no-holds-barred Editors' Choice is the Toshiba Tecra 780DVD. This machine literally ran neck-and-neck with the IBM ThinkPad 770ED right up to the end. The Tecra captured our highest honors because it's an incredibly well-integrated package, which shows that Toshiba put a great amount of research and effort into determining the needs of its target audience for the machine and made sure that the final product met those needs.

The Tecra is aimed at software and content developers as well as on-the-go corporate power users who demand exceptional performance. To that end, the company loaded this 8.9-pound machine with a second-generation DVD-ROM drive with hardware MPEG-2 and AC3 support; a 13.3-inch XGA screen capable of displaying 1,024-by-768 true color; an 8GB hard disk; 64MB of memory, expandable to 192MB; and a digital video camera that captures still or moving images and also doubles as a scanner.

The Tecra integrates a K56flex DSVD voice/fax modem that supports both V.34 and V.80 protocols. Both Intel's ProShare and Microsoft's NetMeeting are bundled for videoconferencing and data-sharing purposes. Also built in is a cellular port for connecting directly to Motorola's Elite or MicroTac phones. The system's performance was top-notch, and its DMI 2.0–compliance and preloaded LANDesk Client Manager ensure that it will be a good corporate citizen.

We also recognize IBM's ThinkPad 600 as an honorable mention. This machine takes the concept of IBM's slimline ultraportable—the ThinkPad 560—and adds a 24X max CD-ROM drive, a 13.3-inch XGA display, and an integrated 56K modem. The result is a notebook that's a bit thicker and a bit heavier than the ThinkPad 560, with a travel weight of 6.5 pounds. But if portability is everything and you must have a CD-ROM drive (and you're willing to pay nearly $5,000), the ThinkPad 600 is a good choice.

ics accelerator—which talks to 4MB of SGRAM across a 100-MHz bus—the system posted the top score on our Winstone test. Also, its Graphics WinMark score outdistanced the average score by 20 percent. Its BatteryMark timing of 2:12 is respectable but lower than its major competitors, the IBM ThinkPad 770ED and the Toshiba Tecra 780DVD.

Another cool feature that the Armada 7800 brings to the table is an integrated AC adapter. This feature helps keep the unit's travel weight down to just under nine pounds. It will also save room in your briefcase, because you won't have to carry around an AC brick. But because of the space it takes up at the rear of the unit, the adapter is also partially responsible for the notebook's lack of a palm rest. Although we found the keyboard well-constructed and easy to use, having no palm rest was a bit hard on the wrists and shoulders after awhile.

The rest of the Armada's impressive array of hardware includes a 13.3-inch XGA display, a 5GB smart hard disk, an integrated 33.6-Kbps modem, a fast infrared transceiver, and a single USB port. The unit's primary smart lithium ion battery is mounted on the side; there's also a MultiBay in the front, which can accommodate a 20X CD-ROM drive, a floppy disk drive (both are included in the price of our test unit), an LS120 drive, a second hard disk, or a second battery. Compaq plans to offer a modular DVD drive in the third quarter of this year. Those who've already purchased Compaq notebooks will appreciate that the Armada is backward-compatible with existing Compaq docking solutions.

If you're looking for a solid, dependable notebook that's also tops in graphics performance, the Compaq Armada 7800 is a good choice.

Dell Computer Corp.

Inspiron 3200 D266XT
Latitude CPi D266XT

Whether you're buying for yourself, a small business, or a large corporation, Dell Computer Corp. has a Pentium II notebook for you. From this direct-market leader comes two systems, the Inspiron 3200 D266XT ($3,199 direct) and the Latitude CPi D266XT ($3,799 direct), targeted at small- and large-business customers, respectively. Both units performed respectably on our benchmark tests, and both are packed with competitive features. But the Inspiron stood out from the crowd as an outstanding value, and therefore the notebook takes home our Editors' Choice award.

The Inspiron proves that you don't have to break the bank to buy the latest in notebook technology. This ebony-colored machine—weighing in for travel at just over 7 pounds—packs a 13.3-inch XGA display, a 24X max CD-ROM drive, and a 3.9GB UltraDMA hard disk. Synchronous DRAM expands up to 144MB, and the side-mounted modular bay can house either the CD-ROM drive, a floppy disk drive, or a second battery. The system's smart lithium ion battery has charge-level indicator lights that you can see (at the touch of a button) without actually removing the pack from the chassis.

The Inspiron didn't burn up the charts on our benchmark tests, but it managed to hold its

own fairly well. It did post the top CD-ROM WinMark test score, and its BatteryMark timing (2:36) placed it in the middle of the group.

Other system amenities include a full-size keyboard with 3-mm travel (although its backspace key is a tad small), a touch pad that's properly positioned below the center of the spacebar, a fast IR port, and a single USB connector. Small stereo speakers positioned above the keyboard are augmented by 16-bit audio with software wavetable support. Dell also preloads Microsoft Office Small Business Edition, with a special power-friendly version of Microsoft Word that lowers CPU utilization and effectively lengthens battery life.

The Inspiron's corporate-focused sibling may be cosmetically prettier with its two-toned gray and plum chassis and sculpted edges, but that doesn't mean it's all about glamour. On the contrary, the Dell Latitude CPi D266XT compares well with this competitive group in both features and performance, although its BatteryMark timing was the shortest here at 2:01.

Under the hood, the Latitude features a 3.9GB Ultra-DMA hard disk, EDO DRAM expandable to 128MB, and a NeoMagic graphics accelerator with 2MB of memory. Two front-loading bays are also present—one is meant solely for the system's smart lithium battery, which quick-charges in about an hour. The second modular bay can take either a 20X CD-ROM drive, a floppy disk drive, or a second battery.

Inside the case are a 13.3-inch XGA display, a large touch pad with firm and responsive buttons, and a full-size keyboard. Audio bases are covered by a Crystal chip set that provides Sound Blaster Pro compatibility as well as adjustable 3-D sound. Speakers that port out the sound are located on either side of the chassis base at the front.

To combat hard disk damage that may occur if the unit is dropped, Dell has engineered a "strike zone," a slight oval-shaped bubble on the bottom of the case where the hard disk is inserted. If the notebook is dropped flat, the strike zone absorbs some of the resulting shock.

The one minor gripe we have with the Latitude involves the cover that shields the notebook's memory sockets. Although this cover is not difficult to remove, it's not secured in any fashion and quite difficult to replace once removed. The cover also has a tendency to catch on and bend the small latches that hold the SODIMMs in place.

The DMI 2.0–compliant Latitude ships with a DMI service layer and MIF preloaded, so the system can be tracked or monitored over a network using standard third-party administration tools. If you want, you can view system information locally through Dell's Inspector 4.1. Standard warranty coverage is longer

SUMMARY OF FEATURES

266-MHz Pentium II Notebooks

	Compaq Armada 7800	Dell Inspiron 3200 D266XT	Dell Latitude CPi D266XT	IBM ThinkPad 600	IBM ThinkPad 770ED	Toshiba Satellite Pro 490XCDT	Toshiba Tecra 780DVD
Price of tested configuration	$5 400 street	$3 199 direct	$3 199 direct	$4 940 street	$5 800 street	$4 000 street	$5 900 street
System/travel weight (pounds)	8.6 / 8.9	6.6 / 7.3	6.4 / 7.3	5 6 / 6.5	8 1 / 9.0	6 9 / 7.7	7.8 / 8.9
Maximum system RAM	160MB SDRAM	144MB SDRAM	128MB EDO DRAM	160MB SDRAM	160MB SDRAM	160MB EDO DRAM	192MB EDO DRAM
LCD panel size, type, and max. [illegible]	13.3" TFT XGA	13.3" TFT XGA	13.3" TFT XGA	13.3" TFT XGA	14 1" TFT XGA	13.3" TFT XGA	13.3" TFT XGA
Graphics chip set	S3 ViRGE/MX AGP	NeoMagic Magic Graph 128XD	NeoMagic Magic Graph 128XD	NeoMagic Magic Graph 128XD	Trident Cyber9397	S3 ViRGE/MX PCI	S3 ViRGE/MX PCI
Graphics memory size and type	4MB SGRAM	2MB EDO DRAM	2MB EDO DRAM	2MB EDO DRAM	[illegible]	2MB SGRAM	4MB SGRAM
Hard disk capacity	4 9GB	[illegible]	[illegible]	[illegible]	[illegible]	2 8GB	8GB
Modem	Included	$149	$149	Included	Included	Included	Included
Data speed (Kbps)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	56 (K56flex)	56 (K56flex)
Type	Integrated	PC Card	PC Card	Integrated	Integrated	Integrated	Integrated
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Standard warranty on parts/labor	3 years/3 years	1 year/1 year	3 years/1 year	3 years/3 years	3 years/3 years	3 years/1 year	3 years/3 years

* Upgradable to K56flex. N/A—Not applicable. This product is not equipped with a DVD drive.

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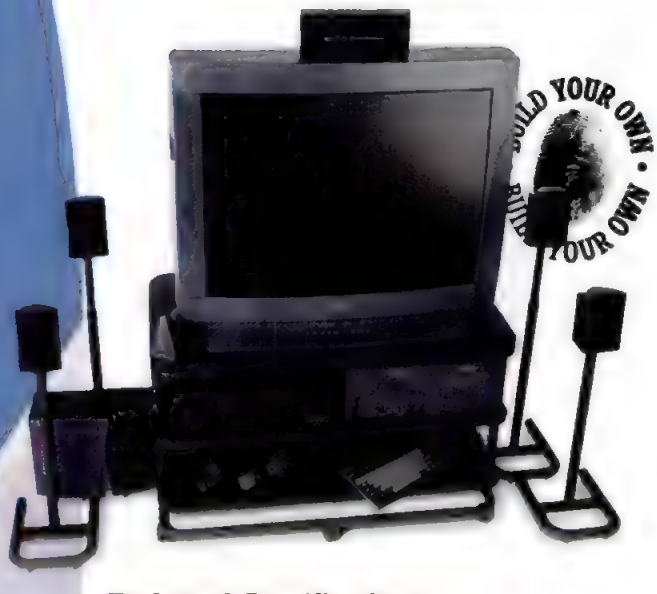

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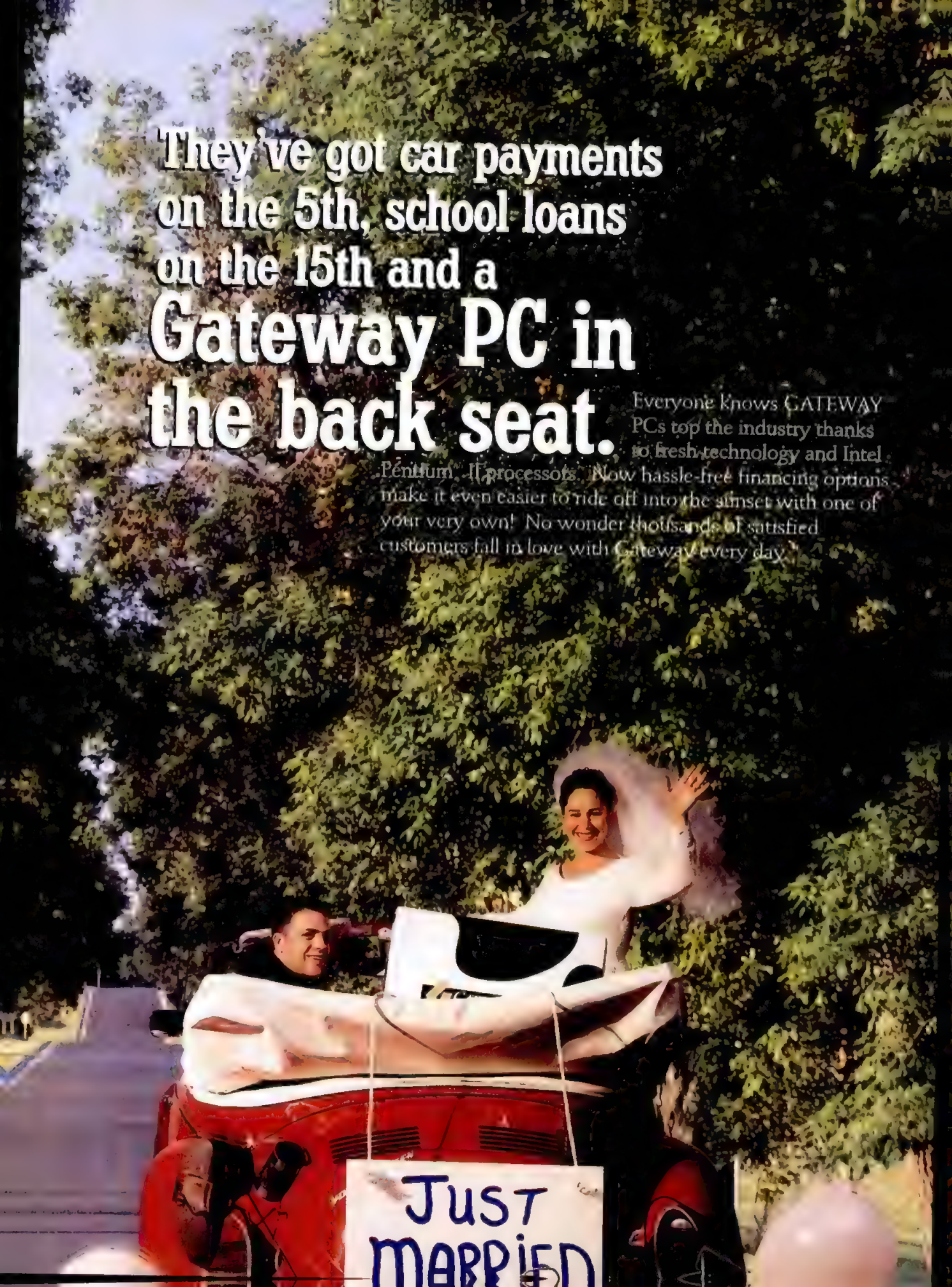
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IBM Corp.

ThinkPad 600 ThinkPad 770ED

IBM brings its expertise in crafting impressive portables to the table once again with two of its inaugural Pentium IIs. The IBM ThinkPad 600 ($4,940 street)—which receives honorable mention in this roundup—is a CD-ROM–equipped, slimline follow-on to the wildly successful ThinkPad 560 series. Meanwhile, the IBM ThinkPad 770ED ($5,800 street) takes the award-winning case design of its predecessor and adds a higher-speed processor. Both of these machines are typical IBM notebooks, leading their respective fields in terms of features (the ThinkPad 600 is literally in a class by itself). IBM will also offer two configurations of its 380-series value system with the mobile Pentium II.

At just 6.5 pounds with a 24X max CD-ROM drive loaded, the ThinkPad 600 is a bit heavier than the ThinkPad 560X. But at 1.5 by 12 by 9.5 inches (HWD), it retains the spirit of the ThinkPad 560X's slim physique. It also ups the XGA display to 13.3 inches on the diagonal, and it integrates a 56K modem. The floppy disk drive can be used either outboard or internally.

The ThinkPad 600 improves upon the previous 560 generation in both battery capacity and battery life. IBM has added a beefier, bottom-loading rectangular lithium ion battery pack (3,200 mAh), which ran for an impressive 3:12 on our BatteryMark test. The vendor has also taken a move from the ThinkPad 770's playbook and added its enhanced TrackPoint pointing device, which supports IBM's Press-to-Select feature (just tap the eraserhead to perform a left or right click). Also present is a third button that can be used instead of the scroll bars to scroll within documents. This button can also enable a magnifying feature that can zoom in on small areas (about 1.5 by 1.25 inches).

This notebook touts all the requisite ports and jacks (including USB, video out, fast IR, microphone, and headphone) as well as a connector for the floppy disk drive. Some are concealed behind rubber-hinged covers, which won't snap off like most all-plastic covers. IBM has also added stereo speakers into the ThinkPad 600's palm rest.

The ThinkPad 600 didn't exactly lead the pack on our benchmark tests. In fact, it posted the lowest scores here on our Winstone, Graphics WinMark, and Disk WinMark tests, although we should mention that the Winstone point spread was by a razor-thin (and therefore insignificant) margin. The unit's 24X max CD-ROM drive turned in the second-highest score, while the BatteryMark score was beaten only by its big brother, the ThinkPad 770ED.

Speaking of big brothers, the ThinkPad 770 is back with the new E series. IBM bypassed the Tillamook 266 for this machine, opting to wait for the high-powered PII processor. In many respects, the ThinkPad 770ED is identical to its earlier incarnation, although IBM has raised the bar on a few key features.

First of all, the vendor has bumped up the SGRAM supplementing the notebook's Trident Cyber 9397 chip set to 4MB, so the ThinkPad 770ED can now display 32-bit color with a 1,024-by-768 resolution. IBM has also increased storage space. This model ships with a huge 8.1GB hard disk; the housing is the same, however, with small holes drilled into the metal casing to shave off weight. Innovations like these allow the ThinkPad 770ED to carry a 14.1-inch display and retain a travel weight of just over 9 pounds.

On our benchmark tests, the ThinkPad 770ED was a top performer, coming in just behind the Toshiba Tecra on the Winstone, Graphics WinMark, and Disk WinMark tests. Its CD-ROM WinMark score topped the Tecra's, however. And thanks to its 4,500-mAh lithium pack, the ThinkPad 770ED lead the group on our BatteryMark test at an amazing 3:46.

One of the ThinkPad 770-ED's most exciting features is its DVD-ROM drive. This second-generation device is augmented on the audio front by SRS 3-D sound, MPEG-2 and AC3 decode in hardware, Dolby Digital audio-out, and stereo speakers built into the lower front bezel of the palm rest.

Once again, IBM has scored big with its lightweight ThinkPad 600 and high-end ThinkPad 770ED.

Toshiba America Information Systems

Satellite Pro 490XCDT Tecra 780DVD

PC MAGAZINE EDITORS' CHOICE

Take one look at the newest Pentium II notebooks from Toshiba America Information Systems and you'll understand why this vendor is number one in the portables space. Toshiba's success hinges in part upon its ability to deliver machines perfectly suited to its target audience, and these systems are no exception. For price/performance-conscious buyers in small and mid-size businesses, there's the Toshiba Satellite Pro 490XCDT

($4,000 street), while the Toshiba Tecra 780DVD ($5,900 street), an Editors' Choice in this roundup, is geared toward corporate power users on the cusp of technology.

These notebooks, though targeted at disparate buyers, have a few things in common. Both integrate 13.3-inch XGA TFT displays. Also, they both have the same keyboard with the familiar green AccuPoint pointing stick and stereo speakers built in above the keyboard on either side of the housing. Both notebooks boot in a fraction of the time it takes other systems to start up, thanks to Toshiba's SuperStart technology, which enables fast power on and off. The Tecra, for example, booted 45 to 75 percent faster than the ThinkPad 770 and the Armada, respectively.

On most other features, however, the gunmetal-gray Toshibas part company. Inside the case of the 7.7-pound (travel weight) Satellite Pro is an S3 ViRGE/MX graphics chip set with 2MB of SGRAM that supports virtual 12-by-10 resolution, a 3.8GB UltaDMA hard disk, and Yamaha 3-D audio, which is also Sound Blaster–compatible.

Other salient hardware features include a 20X max CD-ROM drive (swappable for a floppy disk drive, second hard disk, or second battery), fast IR, a single USB port, and CardBus– and Zoomed Video–enabled PC Card slots. There's also an integrated K56flex voice/data/fax modem with V.80 support for videoconferencing as well as microphone, speaker, and line-in jacks mounted on the front of the case beside a volume-control thumbwheel.

The only hassle you'll encounter with the Satellite Pro involves memory upgrades. In order to access the system's DIMM sockets, you'll have to remove both the battery and whatever is installed in the modular bay, take out three screws, and then remove the palm rest.

On our benchmark tests, the Satellite Pro was a strong performer across the board. Its Winstone score came in just behind this roundup's leaders, while its BatteryMark score was in the midrange at 2:22.

Taking the high road for Toshiba notebooks this season is the Tecra 780DVD. This machine is nothing short of a digital powerhouse, packing such cutting-edge features as a DVD-ROM drive, Dolby Digital surround sound, and even a video-capture camera. If you are a high-end content creator that must stay smartly connected while on the road, this Tecra's the machine for you.

The Tecra 780's DVD subsystem is undoubtedly one of its most impressive features. Toshiba starts with its own second-generation DVD-ROM drive and then integrates an MPEG-2 hardware decoder from C-Cubed Microsystems. To view DVD content in style, there's a 13.3-inch XGA TFT display, which is driven by S3's ViRGE/MX PCI graphics accelerator with 4MB of SGRAM.

Toshiba also includes a very versatile, eye-catching peripheral: a digital video capture camera. This camera is approximately 5 inches tall by 1 inch wide, clips onto the right side of the display, and plugs into its own dedicated port on the rear right side of the unit. The camera adds a tremendous amount of value to the Tecra. With it, you can capture still images or motion video. Also, with the preloaded VideoBrush software, you can use the camera as a scanner. The camera lens swivels side-to-side as well as front-to-back, so you can easily adjust it to capture what you want.

This machine is also well-outfitted for communications. Like other systems here, the Tecra has an integrated K56flex modem with DSVD voice and fax support using the V.34 and V.80 protocols. It goes one better than its competition, however, with the inclusion of a built-in cellular port, so you can directly connect either a Motorola Elite or MicroTac phone. This port is both H.324- and H.323-compliant, so you can videoconference over the Internet as well as standard phone lines. Intel's ProShare 2.0 and Microsoft's NetMeeting 2.0 and VidCap are preinstalled as well.

CANDID CAMERA: *The Tecra's bundled digital video camera lets you take stills or motion video and even scan images.*

To ensure that you will have plenty of storage space, Toshiba outfits the Tecra with an 8GB UltraDMA hard disk. Other amenities include an S-Video in/out port, fast IR, two USB ports, an AC3 digital audio-out jack, and microphone, line-in, and line-out jacks. This DMI 2.0–compliant portable also comes preloaded with Intel's LANDesk Client Manager.

On our benchmark tests, the Tecra was a performance leader. Its Winstone and Graphics WinMark test scores were right behind the Compaq Armada, while its Disk WinMark score was the best of the bunch. And the Tecra's BatteryMark score was an impressive 3:02.

Each Toshiba carries a slightly different warranty. Both are covered for three years on parts, but the Tecra is covered for three years of labor as well. Meanwhile, the Satellite Pro's labor guarantee is just one year. Both machines should please their target customers, but it's the Tecra that really shines. PC

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First Looks

ORGANIZERS

The Handheld That Beams

The Palm III (formerly the PalmPilot) features a sculpted design, 2MB of RAM, and infrared beaming.

By Bruce Brown

The newest handheld device from Palm Computing (a 3Com company), the 3Com Palm III ($399 list), has the same size, weight, and screen as the PalmPilot Personal and Professional models (which remain in the line at $199 and $299, respectively), but it adds more memory, rounder edges, and an infrared transceiver.

The Palm III's back and lower edges are tapered, making it easier to hold and to slide into a pocket. A sleeker-looking docking cradle (which won't work with older models) repositions the HotSync button to the bottom lip of the cradle. The Palm III has a flip-down cover that protects the screen and blocks glare.

The Palm III's 2MB of RAM doubles the storage capacity of the previous top-of-the-line PalmPilot Professional, with room for approximately 6,000 addresses, 3,000 appointments, 1,500 to-do items, 1,500 memos, and 200 e-mail messages. For users with lighter PIM data, the extra memory is handy for adding applications, utilities, and even games from a raft of third-party vendors.

The Palm III's top-mounted infrared transceiver beams single records, all records, or applications between two units held within a distance of one meter. You can also select an address entry as your personal business card to share with other Palm III carriers.

The Palm III's Palm OS 3.0 supports more fonts and character features to improve readability. File Linking, another new feature, lets you select an ASCII-delimited file or address file stored on another PC for updating during synchronization; with this feature, you can transfer sales figures or an updated price list.

ZAP! *Two Palm IIIs can exchange information from up to a meter away.*

Earlier Palm Computing PDA owners aren't forgotten—two programs will help the faithful become beamers. Pilot 1000 and 5000 owners can get a $75 trade-in or rebate if they buy a Palm III. And starting in June 1998, any of the previous models can be upgraded with a $129 module that adds IR capabilities, 2MB of memory, and the Palm III's software. All hardware options will work with the Palm III, except for the Motorola Pager Card.

The Palm III's new design, extra memory, IR data transfer, and improved synchronization features add up to a pleasant evolutionary step for this extremely popular PDA.

3Com Palm III. List price: $399. Requires: 8MB RAM, 12MB hard disk space, Microsoft Windows 95 or NT 4.0. Palm Computing Inc., Mountain View, CA; 800-881-7256, 650-237-6000; www.palm.com. *Choose 410 at www.pcmag.com/infolink*

FORMS SOFTWARE

Fill in the Blanks

Create, fill out, and store forms easily with the newest version of Caere's OmniForm.

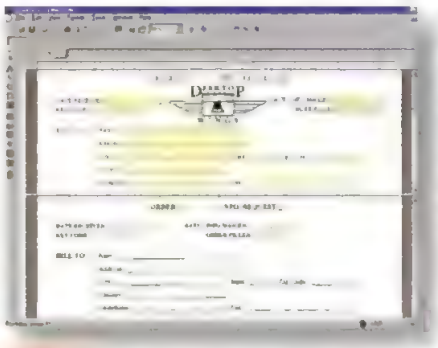
By Alfred Poor

Paperless office? Bah, humbug! Businesses still run on paper, and even small offices have to contend with filling out everything from purchase orders to health insurance claims. Help is on the way, however. Caere Corp. has made it easier than ever to use your PC to create, fill out, and store forms with its new OmniForm 3.0 for Windows ($149 list).

OmniForm 3.0 starts with the same OCR (optical character recognition) engine used in OmniPage 8.0, but it adds "Logical Forms Recognition" technology, which can identify data-entry fields on a preprinted form. This may include the standard fill-in-the-blanks entries as well as more sophisticated items, such as check boxes and circles.

OmniForm works with dozens of scanners (including all Twain-compliant devices), and it takes advantage of Hewlett-Packard ScanJet AccuPage technology. The software can automatically process a scanned or stored image and locate the fields to create a form.

You can modify a scanned form or create your own from scratch. For scanned forms, you can view the form and the original image side-by-side, making it easy to correct any errors. A "print to OmniForm" driver lets you use the output from any Windows application as the basis for a new OmniForm definition. It's easy to add logic, default values, and calculations using a system of reference windows and point-and-click selections. Fields can have pull-down choice lists, validation rules, and automatic formatting.



FORMALITY: *The Form Assistant is an OmniForm 3.0 wizard that guides you through the creation or recall of a form.*

You can choose to print a form, print a form with entered data, or (if you want to print directly onto a preprinted form) print just the data. You can also export a defined form in rich text format for use with Microsoft Word for Windows (though on our testing, this did not preserve the field order).

The program can share a database on a Windows NT network. In cases where you just want someone to fill out a single form on a one-time basis, the program also includes a mailable run-time filler. This filler creates an executable file that includes your form, which you can then send to anyone by e-mail or on disk. The recipient runs the program, fills in the form, and then returns the program. OmniForm then can extract the data.

OmniForm 3.0 is designed for use in small businesses or workgroups where end users are responsible for creating and managing the forms software. Easy and intuitive, OmniForm can be a handy tool to tame your company's paper tigers.

OmniForm 3.0. List price: $149. Requires: 16MB RAM, 10MB hard disk space, Microsoft Windows 95 or NT 4.0. Caere Corp., Los Gatos, CA; 800-654-1187, 408-395-7000; www.caere.com. *Circle 411 on reader service card.*

PHOTOGRAPHY BY THOM O'CONNOR

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IMATION

DIGITAL THEATER

Ultimate PC Home Theater

The Philips DVX8000 and Projectavision system are big ticket, high-performance PC theater components.

By Bruce Brown

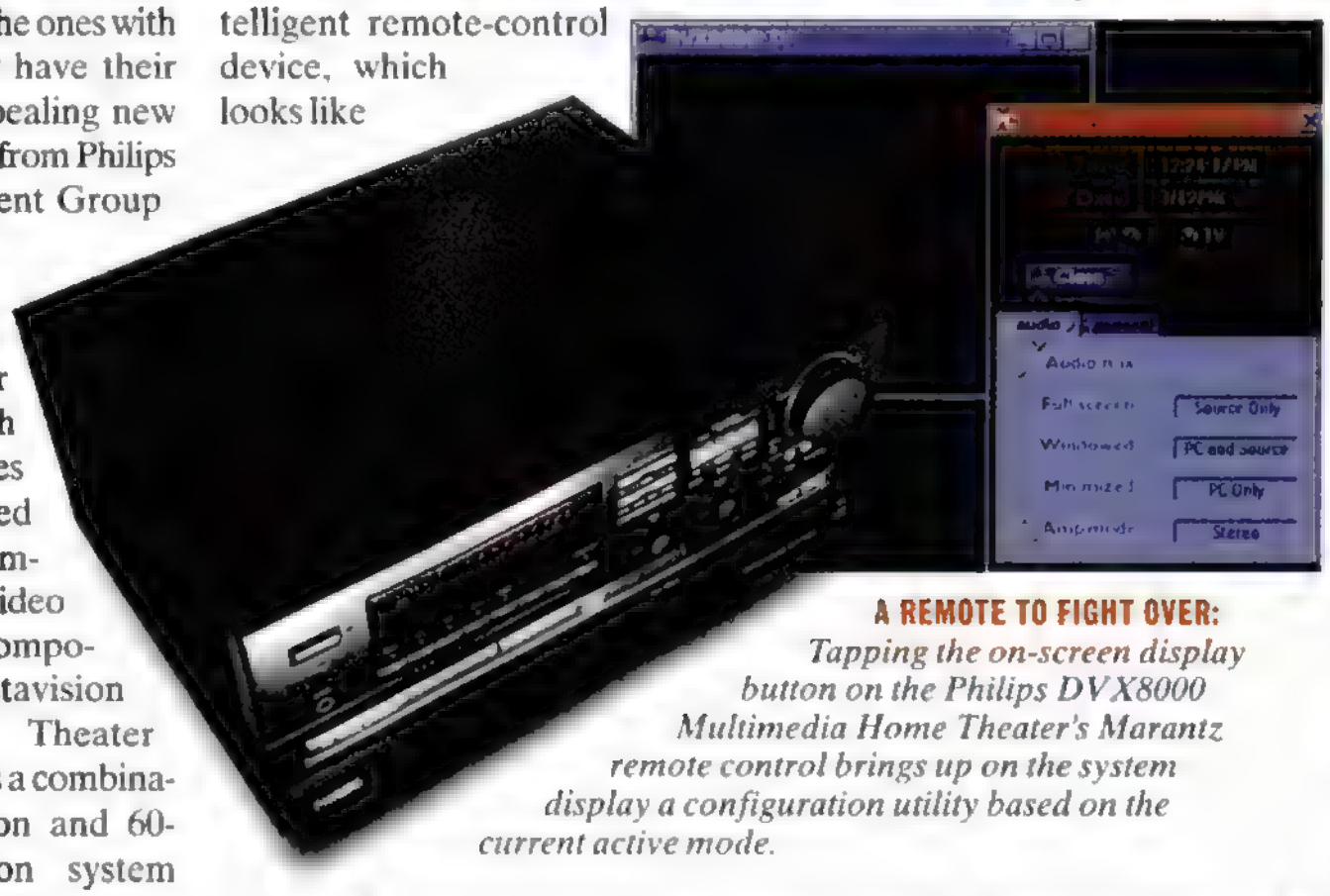
Some people don't need to be convinced that computing and entertainment products can come together to add value to each other. These people—especially the ones with hefty wallets—now have their choice of some appealing new PC theater products from Philips Digital Entertainment Group and Projectavision.

The Philips DVX8000 Multimedia Home Theater ($5,000 list price with no display) combines moderately powered computing with impressive audio and video entertainment components. The Projectavision Digital Home Theater ($10,000 list price) is a combination front-projection and 60-inch rear-projection system ready for affluent homes, boardrooms, and anywhere else a big-screen display is desired.

Either system requires a good AC-3 amplifier/receiver and a full set of speakers (you should figure in an additional $1,500 to $2,000 as a starting point for these added components). But once you put it all together, you could open your own theater and invite the neighborhood in for seriously jaw-dropping entertainment.

PHILIPS DVX8000 MULTIMEDIA HOME THEATER

You won't buy the Philips DVX8000 for its computing features alone. The system's 233-MHz Pentium/MMX processor certainly isn't the fastest on the market, but that doesn't matter much unless you're an avid gamer who chases CPU horsepower and the latest in graphics technology. For high-end audiophiles and videophiles, however, the Philips DVX8000 Multimedia Home Theater hits high on the charts with its A/V features and specifications. When you add the Marantz RC2000X intelligent remote-control device, which looks like it came straight from the Starship Enterprise, the appeal to Philips' target market becomes more clear. For ultimate PC theater, look here.



A REMOTE TO FIGHT OVER: *Tapping the on-screen display button on the Philips DVX8000 Multimedia Home Theater's Marantz remote control brings up on the system display a configuration utility based on the current active mode.*

Five thousand dollars is a lot of money to spend on a multimedia computer without a display, speakers, or even an amplifier. The 8- by 17- by 14-inch (HWD) black case looks more like an A/V component than a PC. A swing-down cover on the bottom front of the Philips DVX8000 reveals the floppy disk drive, game port, USB port, and remote infrared receiver. The Marantz remote control and an IR keyboard complete the package.

The Philips DVX8000's computing components include the 233-MHz processor, 32MB of SDRAM, 512K of L2 cache, a 3.1GB hard disk, a 4MB Trident Microsystems' Linear Accelerator 3-D graphics board, E-Tech wavetable audio, and a 33.6-Kbps modem. Also included is a first-generation Toshiba DVD-ROM drive. When we tried it, the drive worked fine with a selection of DVD movies and CD-ROMs. Like other DVD I drives, however, this one could not read recorded CD-Rs.

The list of included A/V components could fill a page. The preamplifier in the Philips DVX8000 has six-input/three-output audio, four-input/four-output composite video, and four-input/two-output S-Video. This means you can hook up a raft of A/V components, including laser disc players, VCRs, and cassette decks. The system's direct digital video path is augmented by a progressive video line doubler (which makes interlaced television images look smoother), a TV signal tuner, and integral RGB SVGA video out.

Marantz supplies the audio technology in the Philips DVX8000, including Dolby Direct (AC-3), Dolby ProLogic, 5.1 channel, LucasFilm Cinema Re-EQ Circuit, a sound-effects DSP, and an FM tuner. The Marantz remote control comes complete with its own display and button lighting, which brightens and dims automatically. It is meant to replace all of your other A/V-component remotes. And in addition to having codes for a vast number of components, it also has the ability to learn new codes and store 20 macro commands. All A/V components can be controlled independently of the PC functions.

During benchmark testing, the Philips DVX8000 didn't set any records. Focusing just on computing tasks misses the point of this system, though, since the Philips DVX8000's maximum 60-Hz refresh rate at 800-by-600 resolution doesn't lend itself to up-close word processing or spreadsheet workouts.

On the other hand, using the Philips DVX8000 to download television schedules, surf the Web while watching sports events or movies, or play games is more suited to its design intentions. The system is mainly a home entertainment component with an integrated PC that augments the viewing and listening experience.

Watching television and DVD movies with the Philips DVX8000 was a treat. The unit is intended for use with either big-screen televisions or projection systems. With that in mind, we tested it with both the Projectavision reviewed here (in both rear-projection and front-projection mode) and a 36-inch Gateway Destination monitor.

The images displayed on the Destination big-screen monitor were sharp, bright, and crisp. Images were not as clear on the Projectavision in rear-projection mode. The Philips DVX8000 outputs SVGA square pixels while the Projectavision's rear-projection screen is tuned for elongated A/V pixels, which explains why the resulting image was off a bit. When used with the Projectavision in front-projection mode, however, the Philips DVX8000 filled the wall with realistic, high-quality video.

To take advantage of the

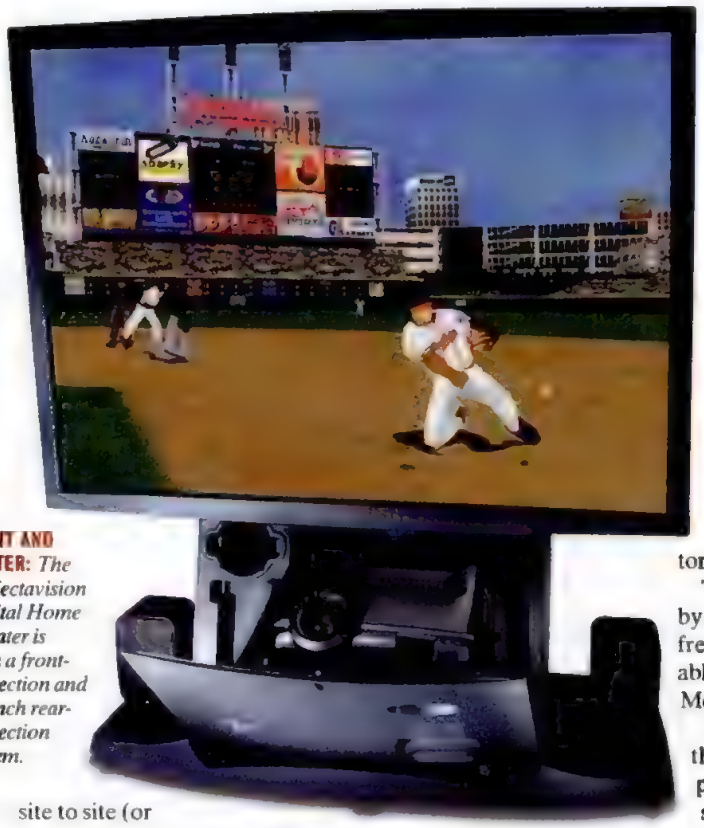
PHOTOGRAPHS BY THOM O'CONNOR

high-quality audio circuitry and audio modes supported by the Philips DVX8000, you'll need amplified speakers. The unit automatically lets you choose from the audio modes supported by the given media. If you want to listen to DVD movies with AC-3 sound, you'll need an AC-3 amplifier or receiver combination along with two front speakers, two rear speakers, a center-channel speaker, and a subwoofer.

Philips backs its DVX8000 with a three-year parts-and-labor warranty with 24-hour, 7-day toll-free technical support. Sold only through high-end A/V dealers, this system also often comes with help from the local reseller.

The Philips DVX8000 is a high-ticket A/V entertainment system with added PC components for content and Internet surfing. Although the unit is only a moderately performing PC, its balance of computing and entertainment features is right on the money for those willing to spend the money.

Philips DVX8000 Multimedia Home Theater. List price: $5,000. Requires: SVGA monitor or television, AC-3 amplifier/receiver with five-piece speaker set and optional subwoofer. Philips Digital Entertainment Group, Palo Alto, CA; 888-486-6272; www.mmhometheater.com. *Choose 408 at www.pcmag.com/infolink.*



FRONT AND CENTER: *The Projectavision Digital Home Theater is both a front-projection and 60-inch rear-projection system.*

PROJECTAVISION DIGITAL HOME THEATER

If you can't decide between a front- or rear-projection system, why not buy both in one unit? The Projectavision Digital Home Theater is an impressive combination system that's also surprisingly portable.

The Projectavision is based on Texas Instruments' digital light processing (DLP) technology, which uses microscopic mirrors to deflect light. This system includes a 60-inch collapsible rear-projection screen, a stand, the projector itself, two powered speakers, and a remote control. The projector can be removed from the rear-projection stand and screen setup and quickly reconfigured for front projection, making it appropriate for fixed-site display in rear-projection mode. And thanks to its portability, you can move the system from site to site (or even between rooms) for different display tasks.

If you intend to use the Projectavision for front projection only, a version called the SOLO-1 is available. It sells for $8,000 and does not include the screen, stand, speakers, and rear-projection lens.

The Digital Home Theater projector produces 800 horizontal lines and has a computer-mode resolution of 800-by-600. Rated at 350 lumens with a 125:1 contrast ratio, the projector uses a 100-watt lamp with a 6,000-hour rated average life.

The 30-pound projection unit measures 8.5 by 16 by 18.5 inches (HWD), although the two-piece rear-projection screen and cabinet measures 64 by 51 by 23 inches (HWD) and weighs 123 pounds. A 3-watt speaker built into the stand works in conjunction with the two 20-watt external speakers.

The infrared remote controls the unit in both front- and rear-projection configurations. The rear-projection stand has a docking port in the front of the cabinet onto which the projector slides for a quick and easy connection. The A/V component ports and jacks are located in back of the stand, which also has storage compartments for the front-projection lens and a second I/O module with identical ports and jacks for use in front-projection mode.

Once you unlock the front of the stand to remove the projector, you push the I/O module onto the back of the projector and switch lenses. After you figure out how to change the configuration, you'll be able to switch between front- and rear-projection modes in less than two minutes.

The 60-inch screen produces an even, bright image that is best viewed from at least six feet away. By using the unit in front-projection mode, you can fill a wall with the image. Although you can use a reflective screen, Projectavision recommends projecting against a light-colored wall (preferably white). During testing (projecting onto light vanilla-colored walls), PC-type images from the Philips DVX8000 and a Gateway Destination—as well as DVD movies and television signals played from both sources—were simply gorgeous. When the Projectavision is in front-projection mode, you have to get within about four feet before you can detect lines or pixels. In both rear- and front-projection modes, there was minor leakage on the bottom of the image.

The Projectavision is backed by a one-year warranty. Toll-free technical support is available from 9 A.M. to 6 P.M. EST, Monday through Friday.

For fixed-location viewing, the Projectavision's rear-projection-mode 60-inch screen is a highly visible, highly viewable method of displaying computer images and multimedia. Front-projection display quality is so good that if the neighbors ask you to come over to watch a movie, they may not let you in the door unless you bring the Projectavision Digital Home Theater with you.

Projectavision Digital Home Theater. List price: $10,000. Requires: SVGA input signal source. Projectavision Inc., New York, NY; 888-559-7588, 212-971-3000. *Choose 409 at www.pcmag.com/infolink.*

Introducing the 17 inch (16.0" viewable)

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The new GS771 is ViewSonic's smallest 17" (16.0" viewable) monitor. In fact, its compact footprint takes up less desktop space than a conventional 14" (various viewable) monitor.

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3-D MODELING SOFTWARE

Make the Earth Move

Even first-time users can create complex 3-D animations with Bryce 3D or Crystal 3D Impact! Pro.

By Edward Mendelson and Luisa Simone

Bouncing telephones and spinning text are two of the effects that even a beginner can create just a few minutes after installing Crystal 3D Impact! Pro ($100 street). If you're interested in creating entire 3-D worlds, MetaCreations' Bryce 3D ($200 street) lets you render and animate amazingly naturalistic landscapes. No matter what your skill level, these 3-D modeling programs will have you easily breathing life into your graphics.

BRYCE 3D

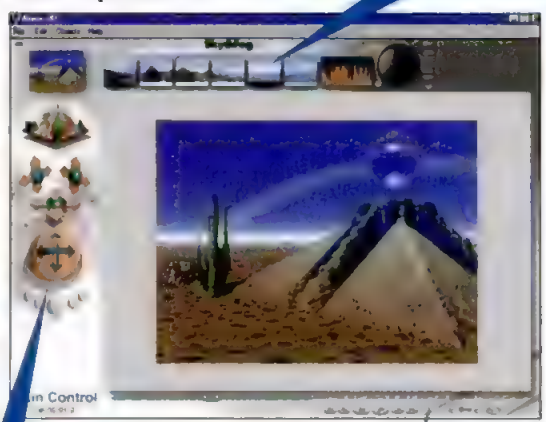
The latest release of Bryce 3D adds animation capabilities to make the earth—and the sun, moon, and clouds—move. Basic keyframe animation controls are tucked away at the bottom of the main workspace and are also found in both the Terrain Editor and the Materials Lab. As a result, you can animate almost any aspect of a scene; you can change day into night or morph metal into glass.

For more experienced animators, Bryce's Advanced Motion Lab displays animation tracks for the individual properties associated with each object (such as rotation). It also allows you to fine-tune the duration of an event or smooth a transition by adjusting curves in the Time Mapping Curve Editor.

Several notable improvements in this version include volume materials that fill objects to create penetrable substances (such as fire), true volumetric lights that interact with one another, and atmospheric effects (such as rainbows). In addition, the existing infinite planes (surfaces that extend to the horizon in all directions) have been supplemented with infinite slabs. Imagine a body of water that obscures objects as they sink into its depths and you'll understand why slabs are an important addition.

Despite Bryce 3D's friendly interface, many of its new functions require effort to master. The rainbow effect, for example, appears on screen only when you've correctly adjusted the camera angle, sun position, and cloud density. We also learned that Bryce 3D's complex textures and sweeping motion effects produce minor but noticeable artifacts when compressed with standard video codecs, such as Intel Indeo 3.2. MetaCreations suggests generating movies without compression.

We highly recommend Bryce 3D to anyone interested in creating fantastically detailed ray-traced worlds. The deep functions of the program—specifically the Advanced Motion Lab and the Deep Texture Editor (where you can create original surface materials)—are the exclusive territory of professional artists and animators. But amateurs can function quite effectively on the surface of this program, where choosing predefined objects and textures and executing simple 3-D operations is as easy as a walk in the woods.



These controls define atmospheric effects, such as rainbows.

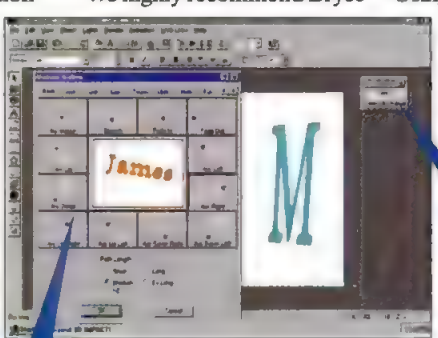
In Bryce 3D, iconic controls let you move through a scene.

The animation controls are discretely tucked away at the bottom of the workspace.

Bryce 3D. Street price: $200 ($99 upgrade). Requires: 16MB RAM, 50MB hard disk space, 16-bit graphics adapter, Microsoft Windows 95 or NT 3.5 or higher. MetaCreations Corp., Scotts Valley, CA; 800-846-0111, 805-566-6200; www.metacreations.com. *Choose 401 at www.pcmag.com/infolink.*

CRYSTAL 3D IMPACT! PRO

Using a wizard interface, Crystal 3D Impact! Pro builds complex, beautifully rendered videos and animated GIF files for presentations or Web sites. Impact! Pro's wizard lets you create animated 3-D text in a half-dozen steps. You can select a background image from 24 supplied samples, enter text using any font on your system, apply one of dozens of prebuilt bezel shapes and surface effects, and then apply any of a hundred motion effects, ranging from fades to spirals and bounces.



You can animate any object using paths and fades.

You can select one or more objects by clicking on their names.

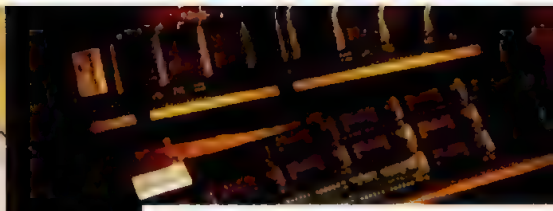
The resulting image can be stretched, rotated, and duplicated. Then you can add other effects, such as shadows and transparencies. After a quick climb up a moderately steep learning curve, we could create animations using imported images in less than ten minutes.

A few rough edges mar an otherwise impressive product. The editing window uses an intuitive set of toolbar tools for common features and a confusingly overpacked top-line menu for less common ones. Unless you study the help file, you probably won't figure out that if you want to change shadow color, you have to use the Ambient Color dialog, not the Shadow menu.

Advanced features (such as embossed effects) appear on bafflingly complicated menus, and the help file isn't much help. An Object Gallery provides 145 3-D clip-art objects, while others can be downloaded from CrystalGraphics' Web site. But the Gallery does not let you search for an object by name, and you have to use Windows Explorer to move files if you want to reorganize the gallery.

Crystal 3-D Impact! Pro's wizards and well-chosen tools make it a good choice for users who want dazzling animations with a minimum of effort.

Crystal 3D Impact! Pro. Street price: $100. Requires: 16MB RAM, 50MB hard disk space, Microsoft Windows 95 or NT 4.0 or later. CrystalGraphics Inc., Santa Clara CA, 800-496-0700; www.crystalgraphics.com. *Choose 402 at www.pcmag.com/infolink.*



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COLOR INK JET PRINTERS

Invincible Ink Jet

Lexmark's 5700 Color Jetprinter features improved paper handling and versatile print modes, all for a low price.

By Bruce Brown

Aimed squarely at the mainstream ink jet printer market, the new Lexmark 5700 Color Jetprinter ($250 street) is a big win for the Kentucky vendor. Using exclusive 3-D laser-cut print-cartridge heads, the new system has a top resolution of 1,200 dpi. The Lexmark 5700 boasts a hefty paper-feed system rated for up to 150-pound stock and class-leading printing speeds. When you add Lexmark's generous bundle of printing software and a next-business-day exchange program (during the one-year warranty period), it's tough not to like this sturdy, all-purpose printer.

The dual-cartridge (one black, the other cyan, yellow, and magenta) Lexmark 5700 switches between four-color CMYK printing for text and graphics and six-color printing for photos (when you pop out the black ink cartridge and replace it with the optional $44.95 black, light-magenta, and light-cyan photo-ink cartridge). Printer status, ink levels, head alignment, and cartridge switching are managed and reported via a printer-control application.

During speed testing with a variety of Windows applications, the Lexmark 5700 proved to be as fast or faster than printers in the same price class from Canon, Epson, and HP. The official rating is a maximum 8-ppm text and 4-ppm color printing.

The Lexmark 5700 continues the company's tradition of producing superior black-text print quality with rich color graphics and good photo-output quality. Only when you look closely at photo print samples will you see minor banding.

The sturdy paper-feed mechanism was error-free when we tested it with a variety of paper stock, including mixed stock loaded simultaneously. Replacement ink cartridges list for $32.95 for black (rated at 600 pages) and $38.95 or $44.95 for color (200 and 500 pages, respectively). The per-page costs are a bit high, so look for discounted cartridges.

The impressive Lexmark Workshop CD-ROM for Photos software bundle may lead you to burn through cartridges with glee. Printing tools, applications, and design aids include 3M's Post-It Notes Design Software; Live Picture's LivePix SE photo editor; ArcSoft's PhotoImpression, PhotoPrinter, and Photo-Fantasy packages for editing, printing, and enhancing photographic files; and Monotype GreetingCardMaker and T-Shirt DesignMaker.

NO JAMS: *The Lexmark 5700 easily handled all types of stock.*

If you want an all-purpose ink jet, the Lexmark 5700 looks like a very good choice.

Lexmark 5700 Color Jetprinter. Street price: $250. Requires: 8MB RAM, 90MB hard disk space, Microsoft Windows 3.1 or higher. Lexmark International Inc.; Lexington, KY; 800-539-6275, 606-232-2000; www.lexmark.com. *Choose 404 at www.pcmag.com.*

PROJECT-PLANNING SOFTWARE

Office Manager

FastTrack Schedule manages projects from start to finish and allows real-time collaboration.

By David Haskin

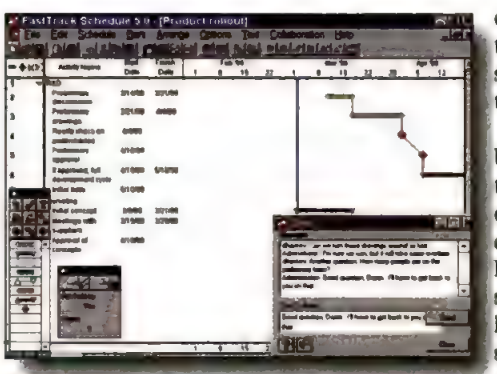
Complex projects can become a trial without precise management and clear communications. FastTrack has long provided powerful project planning and monitoring capabilities, and this upgrade polishes those capabilities and adds real-time collaboration tools.

FastTrack Schedule 5.02 ($200 street) looks like a combination spreadsheet, outliner, and business graphics program. In cells, you enter tasks and subtasks to create a hierarchical outline. You can drag and drop any task or subtask up or down in the outline. As you add start and finish dates to tasks and subtasks, timeline bars or icons appear that graphically display duration or milestone.

You can link the bars and icons to create dependencies. This way, if the schedule for one task changes, the duration of all dependent tasks automatically adjusts. Besides adding start and end times, you can add columns for other data, such as expenses and the percentage of a task that is completed.

FastTrack lets you create templates for the types of projects you plan regularly, and it also supports the formatting of virtually every part of the program, from typeface to gridlines and timelines.

Perhaps the most notable new features are FastTrack's Web publishing and collaboration tools. You can save a project as an HTML table so that it can be posted to a Web server. Also, Microsoft Windows 95 and NT users can now collaborate on schedule management in real time over the Internet or an intranet.



PASS THE PEN: *FastTrack Schedule lets you collaborate in real time over the Internet or your intranet.*

FastTrack displays the PC's IP address, which you then share with others on the network. The others access the schedule by selecting a menu option in their local copies of FastTrack and supplying the IP address. Any collaborator can control the "pen" to edit the schedule and use the real-time text-chat window.

This version also has beefed-up math capabilities. For instance, you can create a column for the cost of all tasks and have FastTrack calculate the sum. Given its spreadsheet look and feel but minimal spreadsheet capabilities, the program should have been able to import Microsoft Excel and Lotus 1-2-3 files directly. Unfortunately, FastTrack imports only ASCII, tab-delimited text files. Even so, FastTrack is simple to use, and collaboration capabilities make it a valuable tool.

FastTrack Schedule 5.02. Street price: $200. Requires: 4MB RAM, 10MB hard disk space, Microsoft Windows 3.1, 95, or NT. AEC Software Inc., Sterling, VA; 800-346-9413, 703-450-1980; www.aecsoft.com. *Choose 405 at www.pcmag.com/infolink.*

PHOTOGRAPHY BY THOM O'CONNOR

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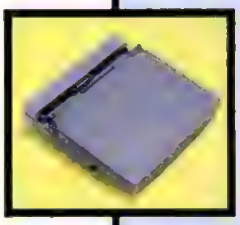

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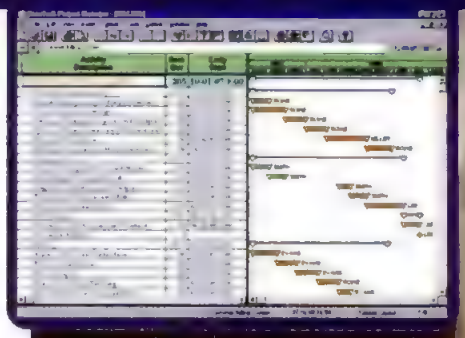

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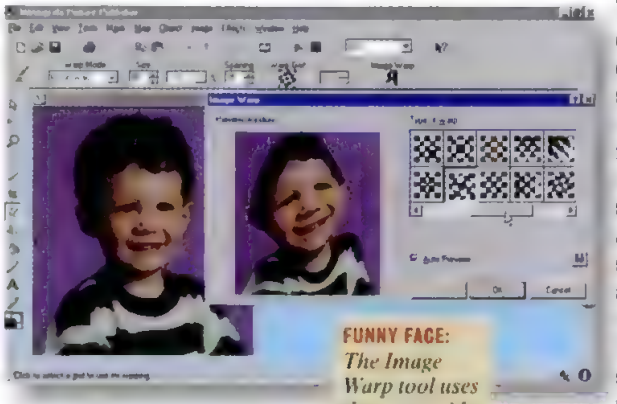
IMAGE-EDITING SOFTWARE

Picture It on the Web

Picture Publisher 8 offers affordable power and an easy-to-use interface to get your graphics on the Web.

By Sally Wiener Grotta and Daniel Grotta

Micrografx Picture Publisher 8 ($150 street) represents a step up in image-editing versatility. This newest version adds depth to existing features and increases the number of special effects and useful macros. But most importantly, it includes new tools for preparing and outputting images for the Web. Unfortunately, these Web tools contain some problematic bugs, but Micrografx promises patches for them.



FUNNY FACE: *The Image Warp tool uses the same grids as the Warp Brush, but the brush is more customizable.*

WEB WORTHY

Picture Publisher 7 was notable for its superb color mapping, which converted 24-bit color to 8-bit for the Web. With Version 8, Micrografx has added several Web-centric features. For instance, you can create, edit, and preview animated GIFs in a straightforward, easy-to-use interface. Still, basic operations could have been streamlined for greater efficiency and fewer mouse clicks. For example, there is no global Use Transparency command, so the user must remember to enable it each time before putting anything into a frame. And even though the GIF animator will import masks as transparency channels, the object or image displays in the frame inside an opaque rectangle rather than the masked irregular shape.

Creating a basic Web page is easy with Picture Publisher 8's wizard, which contains over 40 fully editable Web page templates. The new Bevel Factory makes varied buttons on any shape mask or object. It features a variety of bevel silhouettes, interactive control over highlight placement, different textures, and other commands.

HYPERLINKING

The objects or masked areas of any image can now be defined as URL hyperlinks. Image maps can be copied to the clipboard as HTML documents for pasting into a Web page editor, or they can be exported with the Web Output wizard.

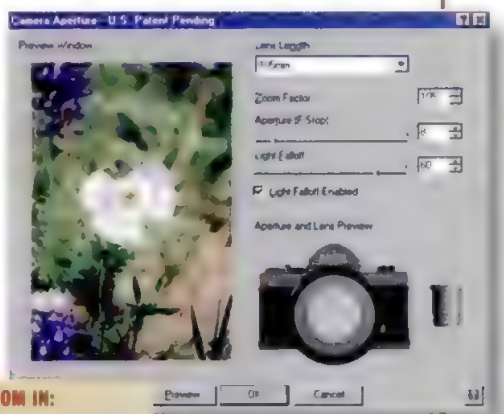
When we used the Web Output wizard and previewed the file in Microsoft Internet Explorer, only some of our hyperlinks had been exported. In addition, the custom-color palette mapping tool does not currently work, although the global Internet Explorer and Netscape Navigator palettes are fully functional. Micrografx promises to post patches for these bugs on its Web site.

By including over 60 new macros, Picture Publisher 8 allows you to perform image-editing techniques with single button clicks that previously took quite a few steps to execute. In addition, all macros are now more logically categorized according to their type of effect. Unfortunately, there is no way to customize macros without having to rewrite them.

EXTRA SPECIAL EFFECTS

Some features, such as the Light Studio and Mask All, go one better than what's available from the competition. For example, the Light Studio's presets offer special effects, such as gold foil or sun glare, which can be a user's reference point in creating and saving new and unusual lighting. Although traditional presets exist (and are editable) in such programs as PhotoShop, Picture Publisher 8's presets are more versatile and appropriate for those who are unfamiliar with lighting effects.

Other new features are unique (or at least leading edge). For instance, you can control depth of field (area of focus) with Camera Aperture as if you were changing the aperture of a camera lens from f1 to f64. You can choose among different lens types (from wide angle to telephoto), and you can also enable light falloff. This, along with several new camera or film-type macros, lends a more photographic nature to Picture Publisher 8.



ZOOM IN: *Camera Aperture allows you to choose among lens types (from wide angle to telephoto) as well as enable light falloff.*

Among the various new interactive special effects is an Image Warp that distorts an entire picture or selected area according to preset grids (these, alas, are not editable). The same grids may be used locally and more creatively by the Image Warp paintbrush.

In an interesting use of the technologies behind Flashpix and Picture Publisher's Command Center (which is a list of all the edits made to an image), Picture Publisher 8 allows the user to edit the low-resolution version of a Flashpix image and then apply the changes to a higher-resolution version. This is done by saving the edited Flashpix picture as a PPF file, which can also save the changes listed in the Command Center. When the changes are applied, the image can then be saved in any supported file format.

Picture Publisher 8 makes professional image editing accessible to nonprofessionals without diminishing the power of its tools or the creative potential of its users. Although the program does not blaze with revolutionary ideas, it responds to the growing need for Web graphics with intelligent, easy-to-use (albeit currently buggy) tools.

Picture Publisher 8. Street price: $150. Requires: 8MB RAM (16MB for Windows NT), 30MB hard disk space, Microsoft Windows 95 or NT 4.0. Micrografx Inc., Richardson, TX; 800-733-3729, 972-234-1769; www.micrografx.com. *Choose 403 at www.pcmag.com/infolink.*

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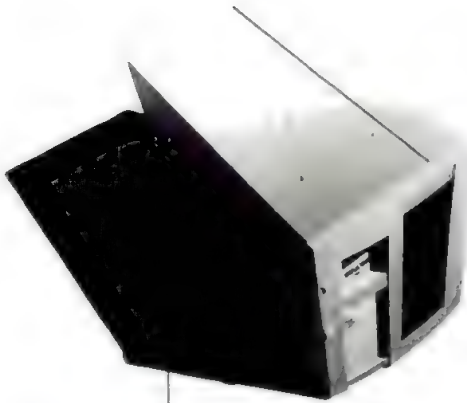

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ISDN MODEMS

Beat the BPS Bottleneck

Eicon's external Diva T/A ISDN Modem incorporates the new Always On/Dynamic ISDN service.

By Les Freed

Eicon Technology's Diva T/A ISDN Modem ($349 list) is the company's first external ISDN product. It's also the first product we've seen to incorporate support for the new Always On/Dynamic ISDN (AO/DI) service. AO/DI uses the ISDN D channel to provide a low-speed, full-time connection between a client PC and a corporate remote-access server or an Internet service provider.

Eicon's choice of product names may confuse buyers familiar with the company's line of internal and PC Card ISDN adapters. Unlike the Diva, those products are available with an optional analog modem, so they can communicate with both analog modems and digital ISDN terminal adapters and routers.

Nomenclature aside, Eicon got the rest of it right on the first try. The Diva is a modem-sided box with ten status LEDs on the front and the usual ISDN, phone, and RS-232 connections on the back. The serial interface can run at speeds up to 230,000 bps. When used with a high-speed serial interface card, the higher speed avoids the 115,200-bps bottleneck presented by standard serial interfaces. Eicon includes a 9- to 25-pin serial interface cable with the Diva.

The Diva's voice support is first-rate. The two POTS phone jacks allow you to connect an analog phone, fax, modem, or answering machine. The Diva provides distinctive ringing and caller ID as well as support for the full range of ISDN calling features (call waiting, three-way calling, and call transfer, for example). You can route incoming calls on either B channel to a specific POTS jack, a useful feature for SOHO users who want to use one ISDN line for incoming voice and fax calls.

The Diva can automatically configure itself on National ISDN-1 lines—the most common type of ISDN line—providing the first true plug-and-play ISDN installation we've seen. If you're using the Diva on a different type of line, you'll have to use the provided configuration program to enter your ISDN line information into the Diva (a quick and easy process).

In addition to the Diva configuration program, Eicon includes Microsoft's Service Pack 1 for Windows 95, Dial-Up Networking 1.2 (which adds Multilink PPP and Virtual Private Networking to Windows 95), WinZip, an FTP client, and Adobe Acrobat Reader 3.0.

Diva T/A ISDN Modem. List price: $349. Eicon Technology Corp., Dallas, TX; 800-803-4266, 972-417-5500; www.eicon.com. *Choose 406 at www.pcmag.com/infolink.*

SHAREWARE

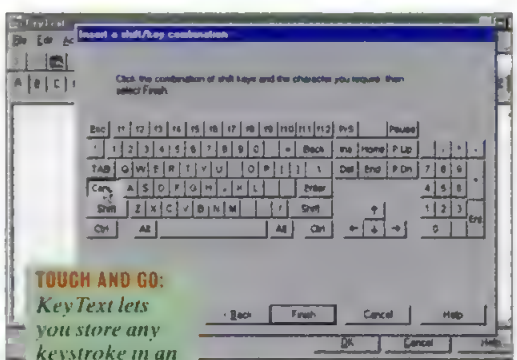
Stroke Saver

MJMSoft Design's KeyText automates your most frequent keyboard and mouse actions.

By Edward Mendelson

You bought a computer to save time, so why can't it type your name and address, company name, and e-mail address for you? And why does it make you press the same buttons whenever you start a program or enter the same passwords? MJMSoft Design's KeyText 1.0 ($25 shareware) automates these and other tedious tasks. It ranks as the most powerful, elegant, flexible, and unobtrusive automation utility ever written for Microsoft Windows 95 and NT.

KeyText performs four basic tasks: entering text, scheduling programs, pushing dialog-box buttons, and gathering text from the clipboard. If you repeatedly type your name and e-mail address, you can store the text as a KeyText "item" and have KeyText type it into an application when you select the item from the program's pop-up menu or when you press a user-assigned hotkey (different strings can be assigned to different hotkeys). The pop-up menu can be brought up from KeyText's icon in the taskbar system tray, or you can assign a hotkey to bring up the menu.



TOUCH AND GO: *KeyText lets you store any keystroke in an automated entry by clicking on a diagram.*

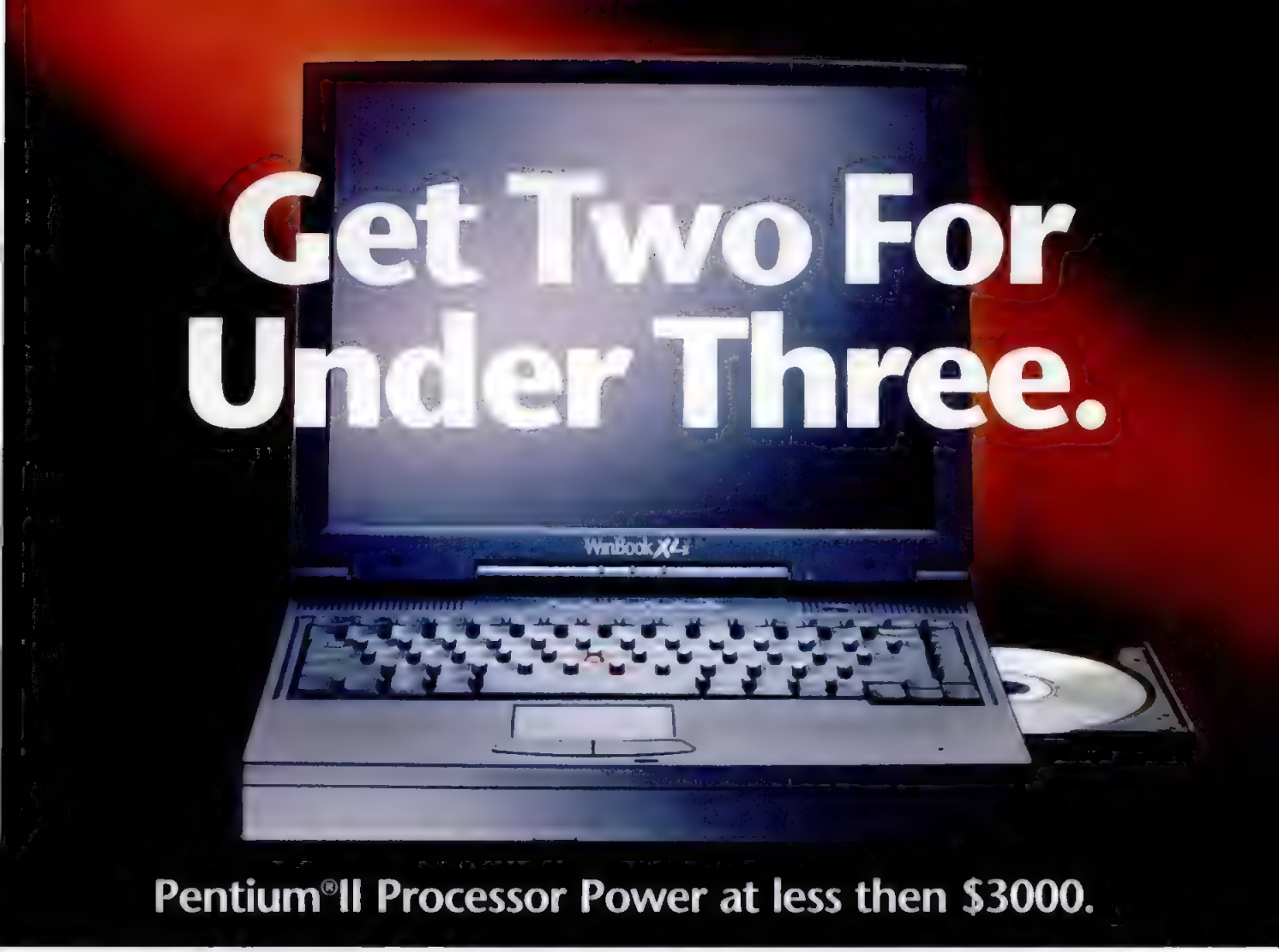
Other KeyText "items" can automatically enter passwords or press buttons on dialog boxes. You simply tell KeyText the title of the dialog box and the name of the key to press or password to enter. You can create items that run programs at scheduled times, or you can copy text in the Windows clipboard to an item for easy entry into other applications. KeyText stores up to 26 items on its menu at a time, but you can switch among different sets of items or keep multiple copies of KeyText active simultaneously, each with a different set of items and a different hotkey and taskbar icon.

Among KeyText's many conveniences are the ability to enter the current date and time anywhere in an automated text string and the ability to launch your browser and open any Web site assigned to the menu or a hotkey. Complex items such as schedules can be created using an intuitive wizard interface. Because you can protect sets of KeyText items with passwords, you can safely store credit card numbers and similar data in KeyText items.

With its compact and efficient design and dozens of conveniences, KeyText is one of the few utilities that belongs on every Windows system.

KeyText 1.0. Shareware price: $25. Requires: 500K hard disk space, Microsoft Windows 95 or NT 4.0 or later. MJMSoft Design Ltd., Edinburgh, U.K., 44-131-449-6768; www.mjmsoft.com. *Choose 407 at www.pcmag.com/infolink.*

PHOTOGRAPH BY THOM O'CONNOR



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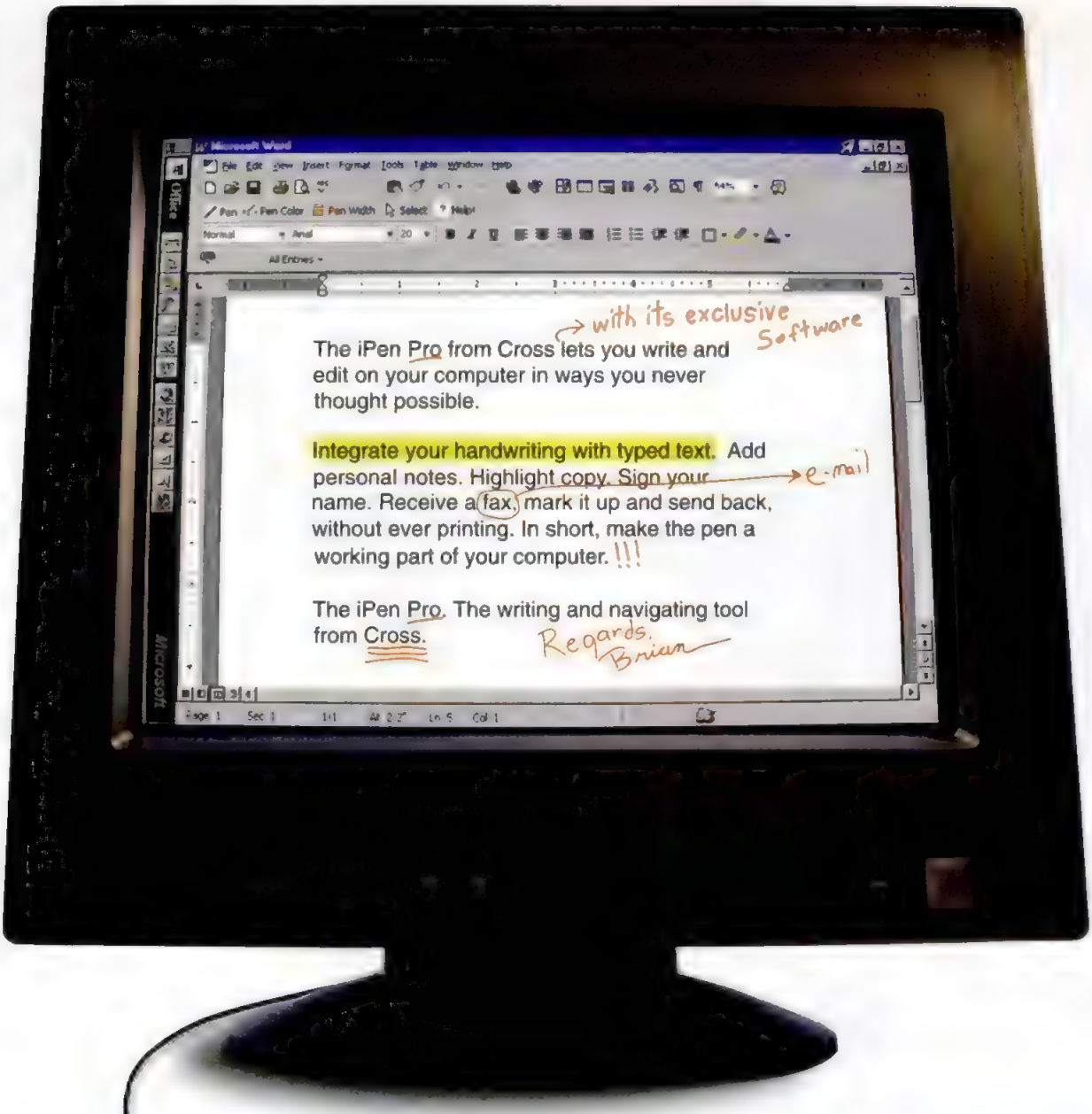

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Second Looks

PLASMAVISION 42EP

Brighter, for Less

By Alfred Poor

Last year, Fujitsu General America's Plasmavision 42—a 42-inch (diagonal) color plasma display—made a big enough impression on us that it captured a 1997 *PC Magazine* Technical Excellence Award for displays. Fujitsu has now released the second-generation model, the Plasmavision 42EP, which offers improved image quality and an improved price: a $3,000 reduction in the list price to $10,999.

This change in the display quality is immediately apparent when you turn on the screen. Fujitsu claims an increased contrast ratio from 70:1 in the original to 400:1 with this model. Though we did not measure the contrast, the claim appears to be credible. Colors leaped from the screen, and images appeared crisp and bright.

Company sources have been tight-lipped about details of the technological changes behind the improvements, but they are willing to attribute the gains to advances that make black pixels blacker (emitting less light) and hold bright pixels at higher levels longer without fading.

The new panel has other improvements that are also worth noting. The first model was fairly quiet, but on the new Plasmavision 42EP, the cooling fans have been replaced with lower-speed units that make operation nearly silent. The panel also has white balance adjustment and improved SVGA compression for handling 800-by-600 images with less information loss.

The company also plans to offer an optional PC Card viewer that will make it possible to play back presentations and display images stored on a PC Card, eliminating the need to connect a computer.

Even though the list price has been slashed by $3,000, the new price still limits the product to board rooms, public marketing displays, and top-of-the-line home theater installations. But if you are in the market for a 42-inch display that's thin enough (6 inches thick) and light enough (87 pounds) to hang on a wall, then the Plasmavision is a better choice than ever.

Plasmavision 42EP. List price: $10,999. Fujitsu General America Inc., Fairfield, NJ; 888-888-3424; www.plasmavision.com. *Choose 400 at www.pcmag.com/infolink.*

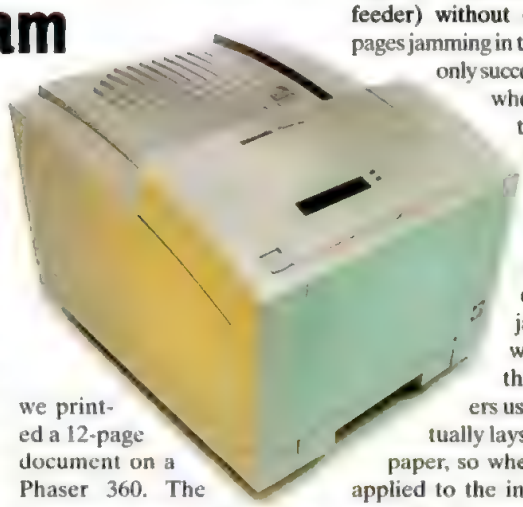
TEKTRONIX PHASER 360

The Copy Jam

By Carol Venezia

In our recent review of Tektronix Inc.'s Phaser 360, we were impressed by the newest incarnation of this vendor's line of solid-ink printers. The Phaser 360 produced brilliant color output, and Tektronix's offer of free black ink as a "feature" helped sweeten the deal. But since that review, we have received numerous e-mail messages from readers who own Phaser 350 printers (the previous-generation unit, also a drum-based solid-ink printer), telling us about a slight problem associated with using these machines.

Our readers claimed that you cannot run pages printed on a solid-ink Phaser through the document feeder of a photocopier without experiencing paper jams. To verify this claim, we printed a 12-page document on a Phaser 360. The document contained mostly monochrome, text-only pages; it also included a page with text and a half-page full-color graphic, a page with text and a small color graphic, and a page with text and a half-page monochrome graphic.



After dozens of tries, we found that it was impossible to copy the entire document (using the copier's automatic document feeder) without one or more pages jamming in the feeder. Our only success came about when we fed just two text pages into the document feeder at a time.

What is most likely causing these jams is the wax-based ink that these Phasers use. This ink actually lays on top of the paper, so when pressure is applied to the ink side of the page, that pressure causes friction. That friction in turn makes pages jam inside a copier's document feeder, and it may also make your originals stick to the copier's glass if they do make it all the way through the feeder.

We then took our research into this matter online. On Tektronix's Web site (*www.tektronix.com*), the company states that with the Phaser 360 "you no longer need separate color and monochrome printers on your network." We found this to be surprising, because if your office is anything like ours, you make lots of copies of printed originals, which is cheaper than producing multiple originals.

We discussed both things with Tektronix. First of all, the company recognizes the copier document feeder issue and expects to resolve it sometime in the future (the problem is also documented on the company's Web site). As far as the product statement is concerned, Tektronix attributes it to slightly overzealous marketing and promised to address it so that the online copy properly reflects the functionality of the printer.

SECOND LOOKS MAILBOX: Tell Second Looks about your experiences with computer products. Contact Carol Venezia at *cvenezia@zd.com.*

PHOTOGRAPHY BY THOM O'CONNOR

It's not a box.
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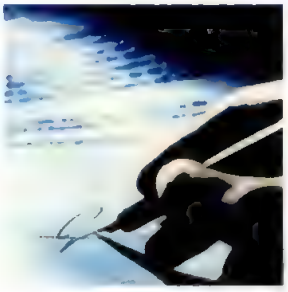

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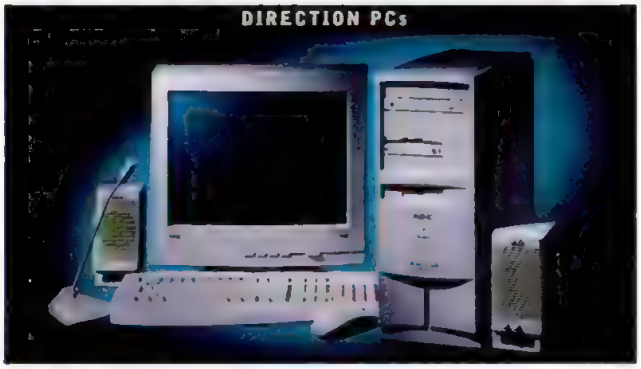

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Direction SPL300 - PC Computing, Mar. 1998

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MMX intel inside pentium® II

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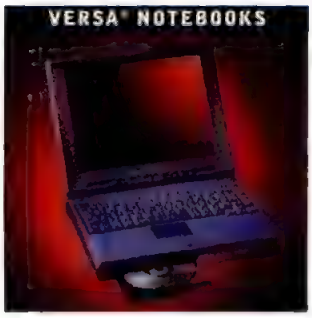
VERSA® NOTEBOOKS



With its built-in 56Kbps* modem, CD-ROM, and floppy drive, a Versa 2700 notebook gives you true all-in-one convenience. It also gives you serious capabilities. Like being able to create multimedia presentations with full-motion, full-screen MPEG-1 video and 3-D stereo surround sound.

"The NEC Versa 2760MT is the ideal mid-range laptop for those who don't want to compromise on performance, presentation or portability."

Portable Computing Direct Shopper, Mar. 1998

Versa 2780MT

- **233MHz Pentium® processor with MMX™ technology**
- 12.1" SVGA Active-Matrix TFT Color Display
- 32MB EDO DRAM (128MB Maximum)
- 512KB L2 Pipeline Burst Cache
- Built-in 3.2GB Hard Drive, 20X Maximum Variable-Speed CD-ROM Drive, 1.44MB Floppy Drive, and Lithium Ion Battery
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Versa 2760MT

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- 256KB L2 Pipeline Burst Cache
- Built-in 2.1GB Hard Drive, 16X Maximum Variable-Speed CD-ROM Drive, 1.44MB Floppy Drive, and Lithium Ion Battery
- Integrated 56Kbps* Modem
- PCI Bus Architecture with NeoMagic 128-Bit Graphics Accelerator
- Stereo Speakers and Subwoofer with 3-D Surround Sound and Yamaha Wavetable
- 32-Bit CardBus and Zoomed Video Support
- USB and 4Mbps Fast Infrared Ports
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- NEC C700 17" Monitor (16" viewable, .27dp)
- Microsoft Windows 95
- **Microsoft Office 97 Small Business Edition**
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NEC Direction Personal Series Desktops

Direction SPB400

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- **64MB SDRAM**
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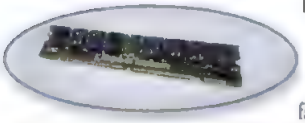

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Using Chips to Make Chips

Making chips has taken on a whole new meaning. A small unit next to my computer is spewing them out, accompanied by the hums and grunts of stepper motors and the whine of a sharp little tool bit as it works a design I created into a block of wood.

I've always had a special love for peripherals that do things in the real world, that interact with the tangible objects that fill our lives. Roland Digital Group's Modela, a computer-controlled, tabletop, 3-D milling machine, epitomizes such gadgets. *Milling machine* may conjure up visions of a massive Bridgeport or Cincinnati mill, with thousands of pounds of cast iron and steel, bristling with knobs and cranks, covered with a fine patina of cutting oil and shop dirt. This isn't that kind of mill. In fact, it doesn't cut metal at all. It takes 3-D designs from your computer screen and renders them in plastic, structural foam, plaster, or wood.

It's a sleek design that's hard to describe, but you can see some pictures of it in action at my Web site (*www.billsbest.com/thmodela.html*). Roland bills the Modela as a 3-D plotter, which is a canny piece of marketing since the concept of a milling machine is probably too industrial for the people who could best harness the Modela's abilities.

Conventional milling machines are good at throwing around the metal chips, too. Apart from a grinder, it's probably the messiest machine to run. I position pizza boxes around my benchtop milling machine (*www.billsbest.com/thatlas.html*) to catch the worst of the debris. Roland's design tames the flying fragments with a wrap-around housing and shield. Plastic and wood chips are a lot more pleasant to deal with than metal chips, but keep a small vacuum cleaner handy.

DIGITAL ARTISAN
Need to build a model in plastic, foam, plaster, or wood? A 3-D milling machine can do the job.

With the Modela and its included software, you can design complex shapes and render them in finished materials or in foam plastics from which you make molds. You can then cast in plaster, metal, or plastic. (A good source of molding and modelmaking supplies is MicroMark, at *www.micromark.com*). You can type in a name or a short phrase, and the Modela will rout the letters out in bold relief from the background. Although the Modela works in three dimensions, it can't rotate or invert the work table, so if your design needs to be freestanding, let the Modela carve the two halves, then glue them together.

What if you want to work from an existing design? Creating a digital model of a 3-D object is a tedious project, but Roland comes to the rescue with the Picza, a companion digitizer (called, appropriately, a 3-D scanner). The Picza has a flat table on which you secure the object to be digitized, embedding it in modeling clay if necessary. A threatening-looking needle comes down, touches the object, and retracts a short way. The table moves a tiny amount, and down comes the needle again. Unlike the diabolical tattooing machine in Kafka's *In the Penal Colony,* the needle leaves no physical trace of its sojourn across the object, but the computer records the precise *x, y,* and *z* location of each contact. From that, the Picza builds a surface map of the object, which you can then scale or modify before producing a copy on the Modela.

Both the Modela and the Picza work with DXF files, so you can use familiar graphics tools to create and modify 3-D objects. The included software is adequate, but high-end drafting and 3-D tools are definitely superior. The Picza can also create VRML output, so you can load the 3-D objects you create onto a Web page and manipulate them with a VRML browser.

Both devices are capable of working to a few thousandths of an inch, but as you might expect, everything takes much longer at higher resolutions. The Picza's needle has all the resolution you'd want, but the memory limitations of the PC-side software limit the size of the scan at high resolutions. The Modela comes with a $^1/_8$-inch (0.125-inch) tool bit, which is fairly coarse for modeling. The manual makes no mention of using other tool bits, but I used 0.090- and 0.060-inch bits with excellent results. I'm going to give some pointed carbide bits a try, too. A 5-inch-long lettering job takes 45 minutes on the Modela with a 0.090-inch bit; a half-inch-square scan of a coin at maximum resolution takes 4 hours, but you can read "In God we trust."

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I'd Bet on Microsoft

The last industry battle looms as Intel and Microsoft have mostly vanquished their competition but still fear each other. Intel is afraid that Microsoft will do something to move the platform off the Intel architecture. This is a paranoid thought and based solely on the fact that at one point Microsoft was going to port Windows NT to everything! Microsoft fears Intel is eventually going to create its own operating system and optimize its chips for its own OS, cutting Microsoft out of the picture. Kind of like what Microsoft allegedly does to people who write applications for Windows. "DOS isn't done until Lotus won't run."

With both companies surviving in a heightened state fueled by intense paranoia and a siege mentality, something has to give, someday. What's interesting is that each company works from a staggeringly different philosophy. In fact, Microsoft's basic thinking is much more contemporary and seems to me to be the thinking that will win any *mano a mano* struggle. Let's examine the differences.

In a nutshell, Microsoft does not suffer from the NIH (not invented here) syndrome common to Intel and some other companies. You run into this mentality mostly in industries that are engineering-top-heavy. The attitude is, "We know the right way to do something. Everyone else is wrong." This kind of thinking flows into standards committees, causing infinite delays as two arrogant know-it-all engineers start butting heads, each claiming infinite wisdom and righteousness. The possibility that they can *both* be right or wrong never enters the debate.

This syndrome dominates Intel's thinking: Intel does not buy technology, it develops technology. Intel licenses nothing except patents for technologies it believes it has simultaneously developed. Intel will use outside technologies when necessary to enhance its direction. Common belief says that Intel invests in companies more to get them on the Intel bandwagon than to incorporate their technology. I'm sure an Intel engineer (who will always be right) will cite numerous examples (all minor) of where I'm wrong in these assumptions, but this is the general thinking. Let me quote from a recent *Microprocessor Report*: "Intel has never in its history produced a part that it did not develop. . . . The company's history and its mindset—some would call it NIH—discourage such a move."

I bring this up because of the fabulous StrongARM chip and its technology, which Digital handed to Intel on a silver platter. Many consider this chip one of the finest low-power chips ever developed, and it looks as if Intel, because of its corporate nature, might simply let the chip die. I recommend you read Jim Turley's excellent editorial in *Microprocessor Report* (February 16, 1998; *www.MDRonline.com*).

INTEL/MICROSOFT
Both companies are surviving in a heightened state fueled by intense paranoia and a siege mentality.

Microsoft is just the opposite. As a development house, it has no NIH-based pride. It prefers to buy technology from someone else. Remember that Microsoft bought DOS from Seattle Computer Products for $50,000 and turned DOS into the cash cow that made the company what it is today. Original DOS code is still in products being sold to this day. Why reinvent the wheel? This is the kind of smart thinking that makes Microsoft so hot. "We didn't think of that idea. We bought it from someone else. So?" If Microsoft's philosophy were used at Intel, you could be certain that the ARM chip would be high on the agenda and turned into a serious profit center. The Alpha chip would be given an Intel part number and pushed into the high end like nothing you've ever seen.

I'm convinced that Compaq and Intel are on a collision course to a merger, and Compaq needs those Alpha chips to run the powerful Digital servers. But with or without the merger, Intel engineers and their NIH problem will dominate the thinking in the company. The result will be the end of the Alpha and the end of the ARM. It's like throwing money away, something Microsoft would never do.

This attitude will eventually haunt Intel. Microsoft is seen as dangerous, because it can gobble up any company or compete on similar products. This is much more frightening than Intel's old-fashioned NIH approach to business, which works only because Intel got a hot hand with its *x*86 architecture and things fell into place quickly. But many of us recall the days of the 8080, when the sudden emergence of the Z-80 chip put Intel into a catch-up mode. And the company has not made flawless decisions. Intel should loosen up a bit. If Microsoft ever got into the chip business, Intel would be doomed.

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Inside Track

Most of the recent chit-chat in the valley is about the **newly discovered instructions** (FXSAVE and FXSTOR) in the latest version of the Pentium II, the 333-MHz Deschutes. These instructions were supposedly designed for fast floating-point save and restore, and some people believe that they were incorporated into the chip at the behest of Microsoft, possibly to **correct some inefficiency** in Windows 98. It's also possible that these new instructions were designed for high-end server use and will not be incorporated into slower chips. There is also talk about this being the beginning of **MMX2.** At this writing, no one is certain whether these FXSAVE/FXSTOR changes can be **retrofitted** into older chips.

The idea that Microsoft can dictate new instructions to Intel is not as far-fetched as it might seem. Microsoft has always done things in a Microsoft-centric manner and backward up the food chain.

The idea that Microsoft can **dictate** new instructions **to Intel** is not as far-fetched as it might seem. Microsoft has always done things in a Microsoft-centric manner and **backward up the food chain.** When people discuss the close relationship that the Microsoft applications designers have with the systems people, you keep hearing the same story: An applications engineer gets an idea for a jazzy feature that's so cool that he (or she) believes the feature should be added to the operating system and become something the application can call up for execution. **This accomplishes three things:** It saves the applications engineer code (and time), allows the new feature to be used by other apps, and gives the Microsoft application **an advantage** in the supposedly level playing field called the marketplace. While Microsoft might officially deny this practice, this is the kind of tactic that serves multiple purposes and is unavoidable. But Microsoft goes even further in its **chummy relationship** with hardware vendors, so chip-level implementations of Microsoft-needed code will sometimes show up. In the early days of the Mac, for instance, it was known that much of the Mac ROM code was added specifically to make porting Microsoft applications easier. We wouldn't want to make these guys work too hard now, would we?

Yet Another Unexpected Breakthrough Dept.: I have no idea how long visible-light lithography will continue to provide us with **cheaper and cheaper** chips. But just as everyone was worried about having to go to X rays or other **new and exotic technologies** to get past the various barriers around 0.18-micron lines, a group out of the University of Texas in Austin headed by grad student Kyle Patterson (option this kid now!) developed a methodology for 0.08-micron lines using plain-vanilla lithography. This means that (gads!) Moore's Law **remains on track** without a lot of additional expense. When will it end?

The Digital Camera Boom Is Coming (Part 10) Dept.: Dataquest is predicting that **over 5 million** digital cameras will be sold in 1998, up from a hefty 2.08 million last year. Supposedly these are going mostly to business users, so **the market will explode** when consumers get into the act. The current leaders are Kodak and Olympus, and both have an excellent line of cameras. Look for Canon and Nikon to get more aggressive with their offerings. Nikon is bringing out a line of cameras that will feature **real Nikon lenses** and real camera controls so that photo buffs can reduce the time they spend altering pictures with Adobe Photoshop. Buyers should make sure the cameras use removable media. Meanwhile Agfa, Apple, Casio, Chinon, Dycam, Epson, Fuji, HP, JVC, Logitech, Ricoh, Samsung, Sanyo, and Sony are among the players in this game. Whom did I leave out? I left out about 30 others; that's how **big a mess** this is going to be!

One of the things we'll see in 1998 is the emergence of the CMOS camera. I have yet to see a decent image from a CMOS sensor, and as CCDs continually improve, I see no reason even to consider CMOS. It's been a known fact for eons that certain kinds of memory chips react to light similarly to the way a CCD chip does. But the **noise factor** is so high that you have to devote a lot of processing power to getting an image that isn't a mess. While the reports on this emerging market hold out high hopes for cheap CMOS-based cameras (especially among consumers), I think the opposite will happen. People will not be satisfied with a CMOS image, and it will hurt sales. No letters, please.

Genuinely Interesting Software Dept.: Since we're on the subject of digital photography, I should mention one of the more interesting **image-editing** software packages. **The king** of such packages is, of course, Adobe Photoshop—and its derivative Adobe PhotoDeluxe. I play with as many of these programs as I can and always forget to mention Picture Window, one of the first packages ever released. It was coded by Jonathan Sachs, the **inventor of the original** Lotus 1-2-3. Selling for a mere $39.95, this editing package is quite different from anything else available, and the user interface is unique (call the company at 617-489-8858 or go to the Web site *www.dl-c.com*). I'm not even sure I prefer the interface, but I **love the features** on this system. Picture Window is designed specifically to fix bad photos by incorporating such things as scratch filters and a cool parallax correction system. Most of the digital cams have a horrid parallax problem. That's where the sides of tall buildings are all bent into an exaggerated convergence toward an **unrealistic** vanishing point. **Correcting this problem easily** was one of the first priorities of this software. Highly recommended. PC

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TCO: Magic, Myth, or Shuck?

TCO, or total cost of ownership, is one of the greatest corporate computer-systems management tools ever to come down the pike. It can lead you almost automatically to better buying decisions, ensure that you've deployed your computing resources in the most efficient way, and give top management the kind of snapshot view of real computing costs and paybacks that makes you, Mr. PC Bean Counter, look like a hero.

Sure. And TCO can also make you taller, better looking, smarter, and sexier and will guarantee that your kids get into Stanford.

Ever since the Gartner Group concocted the TCO methodology for calculating costs and paybacks of computer ownership in business a few years ago, the term has been tossed around with abandon. Dozens, if not hundreds, of consulting shops (including my own) help clients apply TCO analysis to their operations, and thousands of businesses in the U.S. and abroad base the investment of hundreds of millions, if not billions, of dollars on TCO analysis every year. So it's gotta be a Good Thing, right?

Maybe. And maybe not. If you believe in magic bullets and in easy answers to complex problems, you're probably already a TCO devotee. If on the other hand you're a cynic, skeptical of every new notion that floats out of Consultingdom about IT management, then you've probably already dismissed TCO as nothing more than the latest flavor of systems-management voodoo.

Either way, you'd be wrong.

To work both sides of the street for a moment, TCO can be a wonderfully useful way of looking at the real costs of computing infrastructure, and it can be a very valuable way of assessing additional investments in technology. But at the same time, TCO can be misleading to the point of blindness, can be reduced to little more than another CYA waste of time, and can cripple corporate efforts to achieve greater productivity and profitability. Or, as it says in big type on a slide I use often in corporate presentations, "TCO stinks."

Unless you put TCO *into context.*

And unless you're willing to be scrupulously, agonizingly complete and honest when you start counting.

Elsewhere in this issue you'll find lots of material on TCO by our networking guru, Frank J. Derfler, Jr. If you're interested in TCO, read what Frank says. There are few people whose networking and business savvy I admire as much, and he's given you a great head start on making sense of TCO.

TAKEN IN CONTEXT

TCO can be a useful way of looking at the real costs of computing infrastructure.

At the same time, I want to give you my perspective on the applications and misapplications of TCO analysis, based on calculating TCO for many companies and deciding What It All Means.

The first thing that gets attention in TCO calculations is the numbers: By showing the true cost of owning PCs, TCO invariably shocks management—with figures like $7,500, maybe as much as $12,000, per year per PC.

To understand and apply those figures—indeed, to develop them accurately in the first place—you have to understand the concept of *fully burdened costs.* That is, the cost of a PC to a company includes everything having to do with acquiring, using, and disposing of that PC, from selecting the right hardware and software to loading up applications and delivering the box, from user training to networking and other infrastructure, from support to getting rid of the machine when its useful life has ended.

TCO is *not* just the cost of a PC and its software.

Still, TCO newbies ask, how could a PC possibly cost $20,000 to $30,000 or more over its three-year life—a box that may have cost a tenth that to buy?

At my firm, we've compiled the average TCO of PCs at firms we've worked with. The total three-year lifetime costs per PC range from $10,083 to $36,087—and the median figure is nearer the high end than the low.

Which leads to the first key of using TCO: If you're not going to put all your costs into your analysis, why bother? And if you're not going to *believe* your numbers—or are going to be endlessly defensive about them—why go through the exercise?

Second, accept that developing TCO figures is hard work, tracking down numbers that will be difficult to find. Sometimes those difficulties are political—for example, finding the total cost of the IT staff's trade-show and other professional-development travel and entertain-

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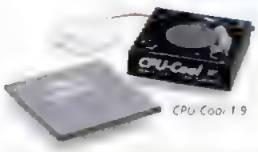

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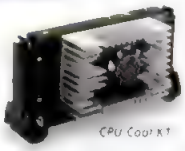
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ment last year—and sometimes they're just hard to find, period. In both cases, ask a simple question if you're not sure what to count: *Would we spend this money if we weren't using computers?* If yes, then forget that cost item. But if no—no matter how far physically or conceptually removed from your PCs the expenditure may be—then you'll have to count it. Period.

Third, and most important, be careful how TCO numbers are used in your company. The number you want isn't TCO, but TBO, the total benefit of ownership—and even more, TRO, or total return on ownership. If you don't have all three, you're not ready to talk about TCO analysis outside your department.

Unless you want to turn your TCO work into a club for people to beat up on you and your staff.

Fair warning: TBO is even harder to uncover than TCO. Calculating the cash value of the benefits of computer ownership is a highly controversial process. Managers are all too ready to add up every cost they can find for acquiring and managing computers, but go ballistic when you try to list the *benefits* of using those computers—and even worse, to put numbers on the value of those benefits.

But TCO without TBO is insanity. Otherwise, why did you go to all that effort and expense to track down costs?

Total *return* on ownership—TBO less TCO—is the ultimate measure of the wisdom of business computing investments. We're in business to make money by investing corporate cash in ways that produce (we hope!) large returns on those investments. Computing systems are no different; but too often, because we fail to calculate the *return* on our investments in these systems, we fail to appreciate in a dollars-and-cents way the rewards of owning or leasing them.

What kind of TRO should you expect? At least a 2X return—and in many cases, more. In large corporate settings, look for a 2X to 3X return. In small businesses, where the leverage of computers can be even greater, look for 3X to 4X. I'm suspicious of higher numbers.

In other words, TCO/TBO/TRO analysis can show that computing investments have a very good return, indeed. If you're effectively doubling your company's money—a 2X return or better—don't undercut your credibility by claiming a suspiciously higher TRO. A 2X return—*a 100 percent return on invested capital*—is plenty to justify your existence. PC

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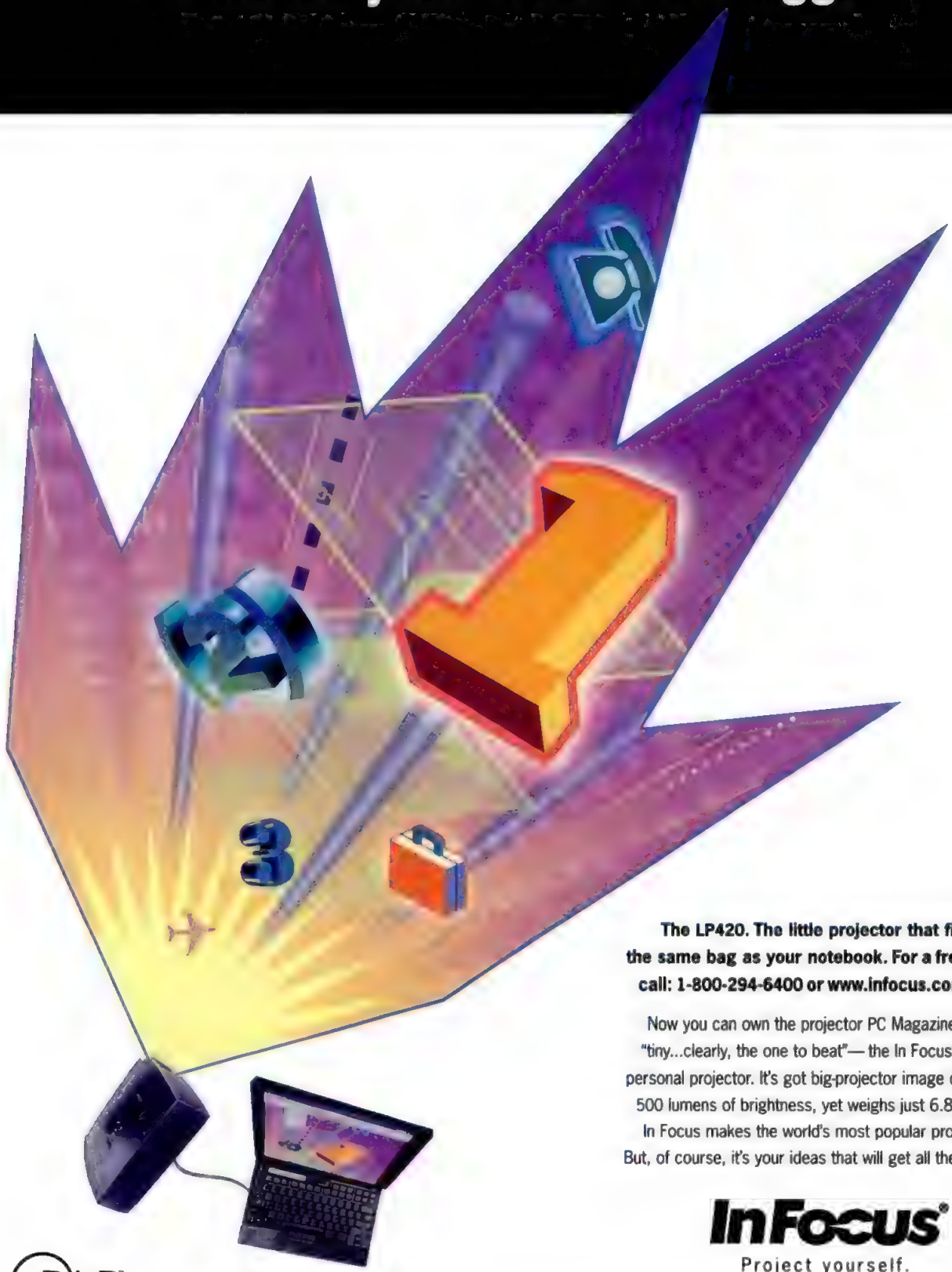

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Faster Remote Connections

With all the heat generated by the 33.6-Kbps–versus–56-Kbps modem debate of the past half year, we've lost sight of an important point: Modems are more alike than different in performance. When Bill Gates promises IAYF (information at your fingertips), you shouldn't have to spend 60 seconds dialing and connecting, then watch your information dribble through at a few kilobits a second rather than thousands.

No analog modem delivers IAYF. Over the past several months, I've installed most of the technologies available to information-hungry small businesses and home users. Here's my take:

POTS. With standard, plain old telephone service (POTS) analog modems, I've seen little practical difference in throughput for e-mail among 14.4-Kbps, 33.6-Kbps, and 56-Kbps modems. But for browsing the Internet, pages download somewhat sooner with faster modems, so you probably should have a 56-Kbps modem *if* your Internet service provider offers higher-speed service. The biggest upside to POTS is that it's ubiquitous, so you can call anywhere, any time.

ISDN. You get a pair of 64-Kbps high-quality data lines, or channels, that can be *bonded* together for a 128-Kbps connection. Connections are virtually instantaneous (although the log-in time doesn't get any faster), and single-channel speed is essentially the same as with POTS modems. For big downloads, the second channel can be invoked automatically. Prices vary widely, but it's not unusual to pay $25 a month for the basic service, plus the cost of an ISDN modem or ISDN router (essentially an ISDN modem connected to a network). The same lines can be used for voice phone calls, fax machines, and even POTS modem dial-up.

NET CONNECTIONS
If cable modem or DSL service is available, get it. If it isn't, consider getting ISDN.

Satellite. This may be the most gee-whiz technology, but satellite data also has the most gotchas. Your Internet data is beamed up to a satellite, then retransmitted back down to you, anywhere on earth. Satellite service is available virtually anywhere you can string a phone line. And that's the first catch: You need a phone line to request the data or to upload your own files. The theoretical throughput—around 400 Kbps—is shared among multiple users; your throughput may drop back noticeably at certain times of day. Pricing can be expensive if you want access during business hours ($100 to $200 a month), and some plans charge by how much you download rather than by time online. One upside: The 21-inch dish also receives high-quality DSS TV broadcasts.

Cable modem. This is a 10-Mbps (theoretical) Internet pipe coming from the same black wire that brings you your cable TV. Like cable TV, it's always on, and you pay a flat monthly fee, typically $40 (including rental of the still-fledgling cable modem); however, availability is limited. Your 10-Mbps pipe is shared with 100 or so other cable modem users, and the throughput feels as if you're connected to a real Ethernet network. For instance, the 7MB patch Microsoft released last year to fix Office 97 took me less than 25 seconds to download. But there's no easy way to share the service among users of a small office or home network. Also, if you forget to turn off file sharing in Windows 95, the entire Internet has access to your PC.

DSL The digital subscriber line (and similarly named offshoots) is the phone company's emerging response to cable modems. Like cable modems, DSL is always on. It offers a high download speed (theoretically, 8 Mbps) and a somewhat slower upload speed, and may have trouble getting to the other side of a corporate firewall. It's also available in only a handful of cities.

Whatever connection option you choose, expect to spend $100 to $500 for the equipment and initial installation, although discounts and deals are commonly available if you ask. Be prepared for hassles of various kinds. My ISDN bill hasn't been correct for a year and a half. And the cable modem installer had to reformat my PC's hard disk to get service running. (It was the PC's fault, but still . . . .)

My recommendations: If cable modem or DSL service is available, get it. If not, consider getting ISDN, especially if you own a small business or work from home and must dial into your company's LAN. If you're thinking about installing a TV satellite dish, installing a dual-purpose TV/data dish is only marginally more costly. Cable modem, DSL, and to some extent satellite data feel markedly faster than POTS modems. But ISDN will be faster than POTS only when both channels are running. PC

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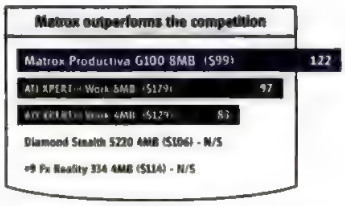

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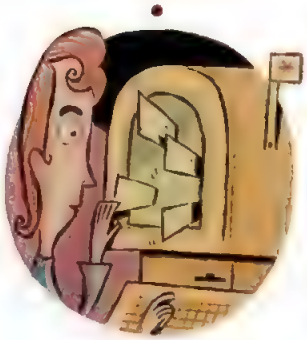

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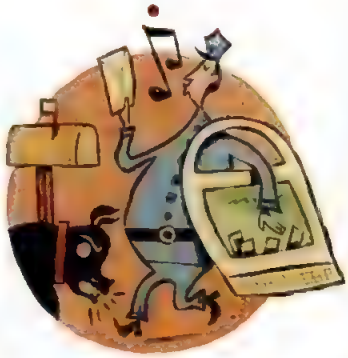
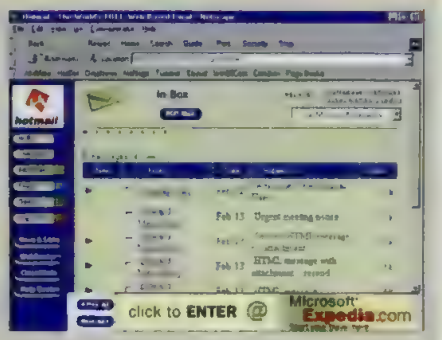


ILLUSTRATIONS BY ADAM McCAULEY

Your Options For E-Mail and Messaging

As the number of users escalates, the options for e-mail have also expanded. Whether you use e-mail for keeping in touch with family and friends or rely on it for critical business communications, you'll find several choices. To complicate matters further, the old divisions between standards-based solutions and proprietary systems no longer apply. Groupware packages now support the key standards, and even online services are getting into the act. So how do you choose? This table summarizes the options for personal e-mail and corporate messaging. To find out more about any of these categories, delve into our hands-on reviews on the following pages.

PERSONAL



FREE-MAIL

Description Free e-mail services are supported by advertising. They're typically provided by Web portals (starting points on the Web) adding services that will attract more visitors to their sites. With the exception of Juno, all of the services allow you to access mail via a Web browser.

Audience A good option for those who travel often and want to be able to check their e-mail without lugging a laptop everywhere. Also great for those who could use a second account to separate their e-mail, such as employees who want to check personal mail at work without using the corporate e-mail system.

Pros and Cons The key advantage is that you can check your e-mail from any PC with Internet access and a Web browser. A disadvantage is that too many of these services leave your e-mail in the browser cache, so anyone can locate your downloaded e-mail easily.

Some Key Products MailCity (*www.mailcity.com*), Microsoft Hotmail (*www.hotmail.com*), Net@ddress (*www.usa.net*), Yahoo! Mail (*mail.yahoo.com*).

ONLINE SERVICES

Description Proprietary services that provide their own software for exchanging e-mail and accessing the Internet. Popular on-ramps to the Internet, the two major online services, AOL and CompuServe, account for about 16 million e-mail users.

Audience Designed for nontechnical users, especially those who are making their first forays online.

Pros and Cons Very easy to set up and use. In addition to e-mail, online services provide Web access, custom content, discussion forums, chat, and other services in a single, integrated interface But they offer limited features in comparison to POP3 clients and only basic filters for blocking spam mail.

Some Key Products America Online ($21.95 a month, 888-265-8003, *www.aol.com*), CompuServe ($24 95 a month, 800-848-8199, *www.compuserve.com*).

In the past few years, e-mail has evolved from an alternative means of communication to a way of doing business. Simply put, e-mail is everywhere. But brace yourself. There are signs that we haven't seen anything yet. Currently, there are about 80 million e-mail users, but by the year 2000, that number will top 100 million, according to the Electronic Messaging Association.

The advantages of e-mail are obvious. As many people are discovering, however, it has potential pitfalls. From the user's standpoint, the onslaught of messages from colleagues and clients, family and friends, and Internet mailing lists can quickly become unmanageable. And there's no guarantee that messages will arrive safely or look exactly the way the sender intended. From the administrator's standpoint, incomplete standards and security concerns can make messaging feel like a minefield.

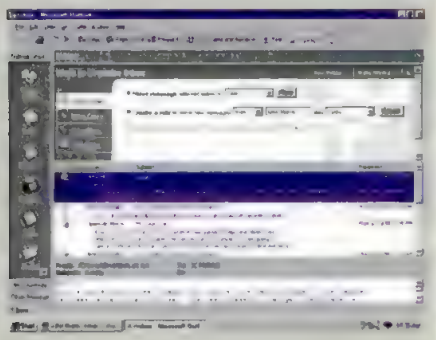
As a messaging platform, the Internet is undergoing some growing pains. But e-mail is here to stay and will continue to mature. In this story, we sort out all of the options available to you, whether you're an individual with a dial-up account, a small-business owner searching for a messaging solution, or part of an organization that's evaluating groupware packages.

Most e-mail users can be divided into one of two camps. In the first category are home and small-business users who rely on an online service or an individual dial-up account with an ISP (Internet service provider) to handle e-mail. In the second are users within larger organizations that have company-wide messaging solutions. In the case of big business, the messaging platform is typically part of a complete groupware solution such as Lotus Domino. But for smaller organizations, groupware can be overkill. Another option is a mail server based on the IMAP4 (Internet Messaging Access Protocol—Version 4) standard.

In the first section of our story, "The Client Side," we review 15 major Internet e-mail clients, including those of America Online and CompuServe (MSN uses Microsoft Internet Explorer and Outlook Express). We also review 9 free-mail clients—typically browser-based services that provide you with free e-mail.

In "The Server Side," we turn our attention to the corporate side of e-mail. Our coverage includes 16 mail servers compatible with IMAP4. Among these IMAP4-compliant messaging systems are 5 complete groupware solutions.

CORPORATE



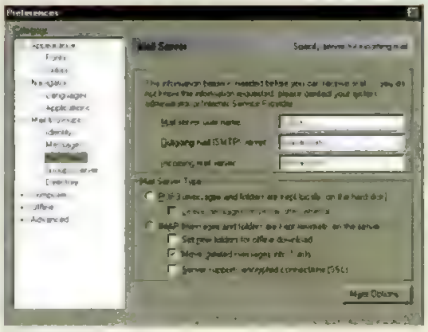
POP3

Description POP3 stands for Post Office Protocol—Version 3. The first standard for Internet e-mail, POP is an off-line protocol: It provides a message store that holds incoming e-mail until users log on and download it. All pending messages and attachments are downloaded at the same time and then deleted from the server.

Audience POP3 is a simple but effective messaging protocol for users who access their e-mail from a single system.

Pros and Cons Because POP3 is so widely supported, users have the best selection of software to choose from. The POP3 e-mail clients we review are quite mature and provide a host of features for the power user. POP3 is not well suited to individuals who check e-mail from multiple systems.

Some Key Products Qualcomm's Eudora Pro Email 4.0 ($40, 800-238-3672, *www.eudora.com*), Microsoft Outlook 98 ($110 street, 800-426-9400, *www.microsoft.com*) and Outlook Express 4.0 (free, 800-426-9400, *www.microsoft.com*), Netscape Messenger (free, 800-638-7483, *www.netscape.com*).



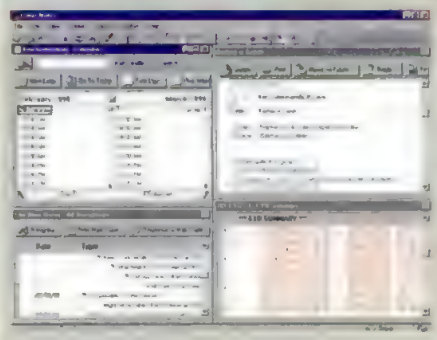
MAIL SERVERS (IMAP4)

Description A more sophisticated messaging protocol, IMAP4 (Internet Message Access Protocol—Version 4) lets you work with e-mail on a server as if it were on a local PC. IMAP provides the same functionality as POP but can be used online to scan message headers and select messages to download, file mail in server or local folders, and share mailboxes.

Audience A good alternative for small to midsize organizations that need robust messaging platforms but do not need the other features found in groupware.

Pros and Cons From the client standpoint, IMAP is ideal for users who access mail from multiple systems, because they can keep all message stores in sync. The ability to download message text but not attachments preserves bandwidth. But unlike groupware, IMAP provides no calendaring and scheduling or threaded discussion capabilities.

Some Key Products Eudora WorldMail Server 2.0 (10 users, $159; 800-238-3672, *www.eudora.com*), Ipswitch IMail Server 4.0 for Windows NT (unlimited users, $495; 781-676-5700, *www.ipswitch.com*), Sun Internet Mail Server (Departmental, $1,495; Enterprise, $3,495; 800-786-7638, *www.sun.com*).



GROUPWARE

Description These LAN-based software solutions provide corporate messaging and more. Additional features include calendaring and scheduling, threaded discussions, project collaboration and document management, HTTP services, and applications development.

Audience Predominantly for midsize to large organizations, though major vendors such as Lotus and Microsoft offer starter kits for smaller businesses that want to deploy groupware.

Pros and Cons A secure, reliable, and scalable store for corporate mail and other types of documents. Provides a whole range of applications for improving productivity and allows organizations to develop their own custom enterprise applications. More difficult to deploy and administer than simple messaging systems.

Some Key Products Lotus Domino 4.6a ($1,495 per server, 800-343-5414, *www.lotus.com*), Microsoft Exchange Server 5.5 (Enterprise Edition: 25 users, $3,549; Standard Edition: 5 users, $2,129; 800-426-9400, *www.microsoft.com/exchange*), Novell GroupWise 5.2 (10 users, $1,421; 800-453-1267, *www.novell.com/groupwise*).

THE E-MAIL MARKET

If you're confused by all the options out there, don't worry—you're not alone. E-mail and messaging can be baffling. Perhaps the best way to understand what's out there is to take an in-depth look at the types of e-mail solutions and whom they are meant for—beginning with users.

The simplest and certainly the least expensive e-mail option is free-mail. As its name implies, free-mail is a free, advertiser-supported e-mail service that you typically access using a Web browser and your existing Internet connection. As more sites vie for your attention by transforming themselves into full-service Web "portals," the number of free-mail services is expanding. Free-mail is ideal for users who do not send and receive large volumes of mail and can live without the features found in more robust standalone e-mail clients.

Another advantage is that free-mail lets you access your e-mail from any system with a browser and an Internet connection, be it a desktop computer at a client site or an airport kiosk. This concept is so compelling that groupware vendors such as Lotus, Microsoft, Netscape, and Novell are adding similar services that convert the contents of mail files to HTML on the fly for access from anywhere.

Like most browser-based applications, though, free-mail services are quite basic. Users who spend a lot of time online or exchange larger quantities of e-mail will want the added features of a standalone client.

The two online services America Online and CompuServe (both now owned by America Online Inc.) each include e-mail clients with their Windows software. An online service may be a good option if you are new to the Internet, because the software typically takes care of the setup. The clients in the versions we tested, America Online 4.0 and CompuServe 3.0.1, provide some basic message-formatting options, as well as features such as filters for controlling spam mail. But because they are proprietary systems, any formatting is lost when you send messages across the Internet. And in terms of features, neither client can rival a true standalone e-mail client.

Today most standalone e-mail clients rely on a standard

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CAN THE SPAM

Sometimes having an e-mail account makes you feel as though you're in a Monty Python skit: spam, spam, and more spam. But you're not powerless in the fight against unsolicited e-mail.

Many of the e-mail clients we review include special filters designed to block spam. For instance, Microsoft Outlook 98 highlights messages that look like spam or contain adult-oriented content. If your e-mail client doesn't have a spam filter, you can use its filtering tools to create one.

A few third-party products can also help. One is Spam Buster ($19.95 list; Contact Plus Corp., *www.contactplus.com*), which compares incoming messages to its database of known spammers to head off junk mail before it reaches your in-box.

A couple of tricks can also help.

- When the sender of unsolicited e-mail offers to remove you from a list, don't fall for it. This just confirms that your e-mail account is active, and you may actually receive more spam.
- Send a message to your ISP or online service telling it that you received unsolicited mail and provide the originating address. In most cases, the return addresses are phony, but your service provider may be able to take action to stop the spam.

called POP3 (Post Office Protocol 3). All of the e-mail clients we review—except for the clients of the online services—support POP3, which defines how a client PC can access mail from a server. POP3 lets the workstation either download mail, thus removing it from the server and storing it locally, or keep mail stored on the server. It's a good solution for home and SOHO users who typically access their e-mail from a single system. And the POP3 clients we review are very capable. They allow you to use multiple accounts, customize folders, and create filters to handle incoming mail automatically.

However, POP3 is not without its limitations. It has no mechanism for replicating mail so that a user could maintain copies of a mail file at work, at home, or on the road. This is not just an inconvenience, it's also risky. When messages are downloaded and permanently deleted from the server, there's no backup in case messages are accidentally deleted, or the data on a desktop system is lost or damaged, or a laptop gets swiped. If messages remain on the server permanently, then workers cannot access or work with e-mail without a network connection. And without the ability to file messages on the server, e-mail can quickly become unwieldy.

ENTER IMAP

IMAP4, a newer standard, addresses many of the inherent limitations of POP3. IMAP4 brings groupwarelike functionality to Internet e-mail. It lets users manage e-mail that resides on the server. For instance, users can sort messages into folders, delete messages, or scan the headers and select specific messages to download. More significantly, they can maintain separate copies of their mail files so that they can work off-line and later resynchronize these copies with the server. About half the e-mail clients reviewed also support IMAP4.

On the corporate side, we were generally impressed with the current crop of IMAP servers. IMAP4 is a good solution for smaller organizations that are seeking a rich messaging platform but don't need the collaboration tools found in groupware.

Note that major groupware vendors are also targeting this small-business market. Microsoft's Small Business Server (which includes Microsoft Exchange) and Lotus's Domino Intranet Starter Pack are both competing with IMAP-only servers for a share of this messaging market. And Novell GroupWise has always scaled well in a NetWare environment, from file-sharing arrangements for small groups to client/server environments for larger groups.

THE STATUS OF STANDARDS

With all the activity around open standards, you'd think that larger organizations would also be rushing to chuck their proprietary groupware systems. But that's not the case. There are several reasons why.

E-MAIL AND THE LAW

[illegible]

First, the standards that exist today do not support the same kinds of features that proprietary systems deliver. For instance, we've been waiting years for a standard that would allow calendaring and scheduling across intranets and the Internet. Although some progress is being made, the standard is stuck in the proposal stages. A standard, NNTP (Network News Transfer Protocol), does exist for threaded discussions, but like POP3, it is quite limited.

Second, not all of the existing standards have been widely adopted. A good example is MHTML, a protocol for encapsulating HTML documents and their accompanying graphics into a MIME (Multipurpose Internet Mail Extension) attachment. This allows the user to create more sophisticated messages that until recently were possible only within the confines of proprietary groupware solutions. Newer e-mail clients such as Microsoft Outlook 98, Microsoft Outlook Express, and Netscape Messenger support MHTML.

In the long term, this will be a wonderful advance. Unfortunately, you can't assume that the people you're messaging have e-mail clients that support MHTML. If they don't, they're likely to receive the message as an attachment that the mail system may not know how to handle properly.

Finally, security is an issue for larger organizations. For example, one weakness is that open systems do little to prevent a user from sending e-mail under a phony e-mail address—a practice known as *spoofing*. Until better tools for authenticating users are available, large companies will be reluctant to make a complete switch to open standards.

For all these reasons, the demand for groupware solutions remains strong. The five groupware packages we review—Lotus Domino, Microsoft Exchange, Novell GroupWise, Netscape SuiteSpot, and Fujitsu's TeamWare Office—provide a more secure, robust, and reliable messaging solution. They also go beyond basic messaging to provide calendaring and scheduling, threaded discussions, and shared folders.

Although proprietary systems still provide richer features than standards-based messaging, groupware vendors are not about to get left behind in the sprint toward open standards. Domino, Exchange, and GroupWise support both POP3 and IMAP4. They can also expose their address books using LDAP (Lightweight Directory Access Protocol) so that users can look up addresses from most Internet mail clients.

The complex terrain of e-mail can be daunting. And the landscape keeps shifting before our eyes. But with an understanding of the key standards and the products that best meet your e-mail needs, you can find your way to the right solution. PC

IMPOSING ORDER ON YOUR E-MAIL

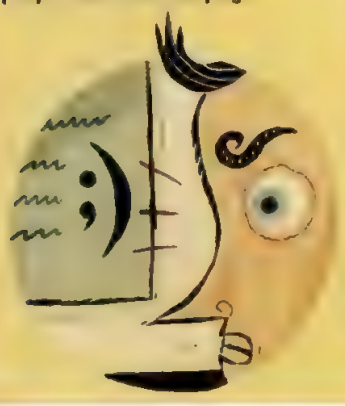
With technology, little is easy, and e-mail is no exception. Many users have both business and personal accounts. And e-mail clients are often used by several people, especially in the home. Here are some tips to simplify things:

- Configure your e-mail client to poll all your accounts at once.
- If security is not a concern, configure your e-mail client to remember passwords.
- Make folders for all your accounts and use filters to route mail to them automatically.
- Get a free-mail account for personal e-mail or mailing lists.
- Pick an e-mail client that offers robust support for multiple users. See our main story.
- Share an account with other family members. Some e-mail clients can sort incoming mail to personal folders based on extra characters inserted at the end of the address.
- Get an e-mail notifier, as discussed in "The 1998 Utility Guide" (March 24, 1998).

RULES OF THE ROAD

Following e-mail etiquette makes your messages easier to read and helps avoid tie-ups on the Internet. Here are some useful tips.

- Be brief. This not only saves bandwidth but also cuts down on eyestrain.
- Don't copy the full text of a long message into your response. Copy only the parts you need to refer to.
- Write in short paragraphs and insert a blank line after each paragraph.
- Make the subject line precise.
- Avoid using all capital letters. IT'S THE EQUIVALENT OF SHOUTING!
- Don't assume that everybody likes emoticons (emotional icons). Some people find them annoying.



SAFE AND SECURE

Security is a hot topic, and many of the e-mail clients we review here offer secure messaging features. Most are based on either S/MIME (Secure Multipurpose Internet Mail Extension), an emerging standard available from many vendors, or PGP (Pretty Good Privacy), an encryption scheme that has been around longer but seems to be losing momentum because of its proprietary status. Both S/MIME and PGP use *hybrid dual key encryption*, a system that employs public keys to encrypt messages and private keys to decrypt them. S/MIME doesn't provide seamless security yet. But one day, secure messaging may be as commonplace as secure communication with a Web server. For more on secure messaging, see "Your Personal Internet" (September 9, 1997).

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1

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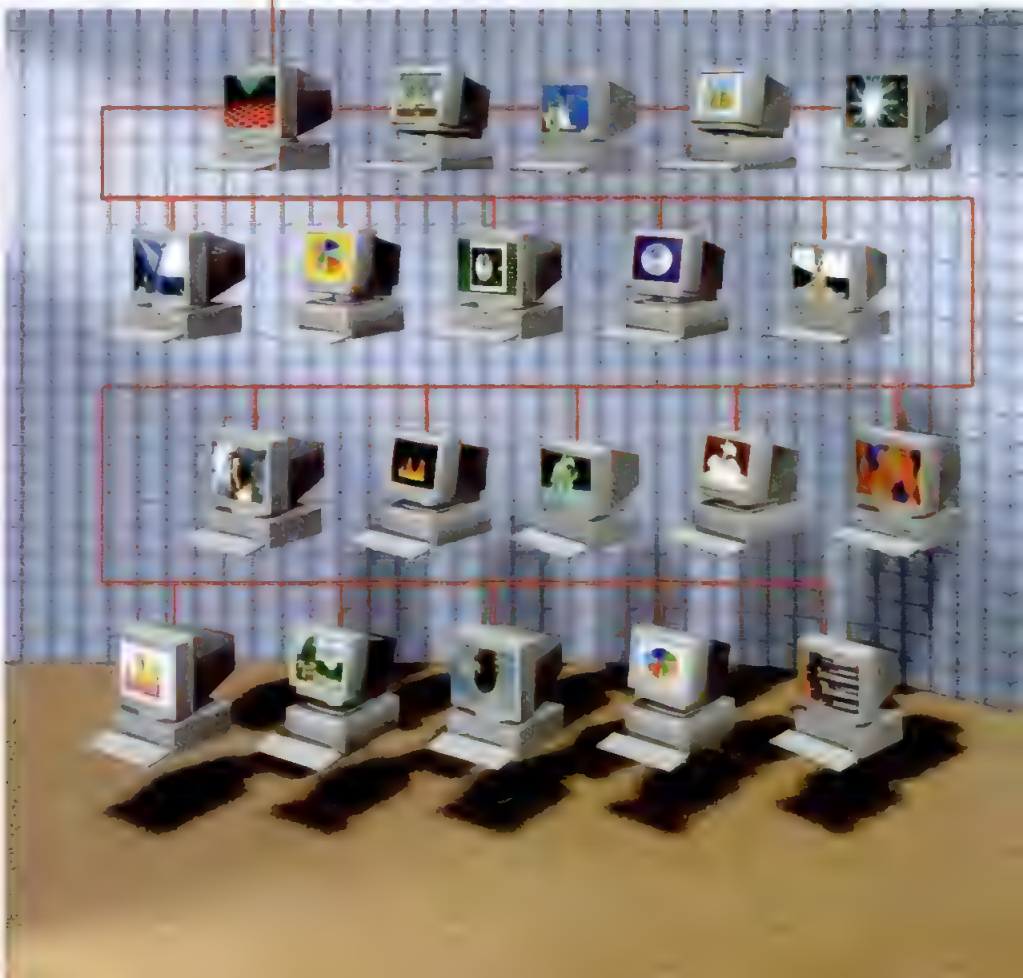

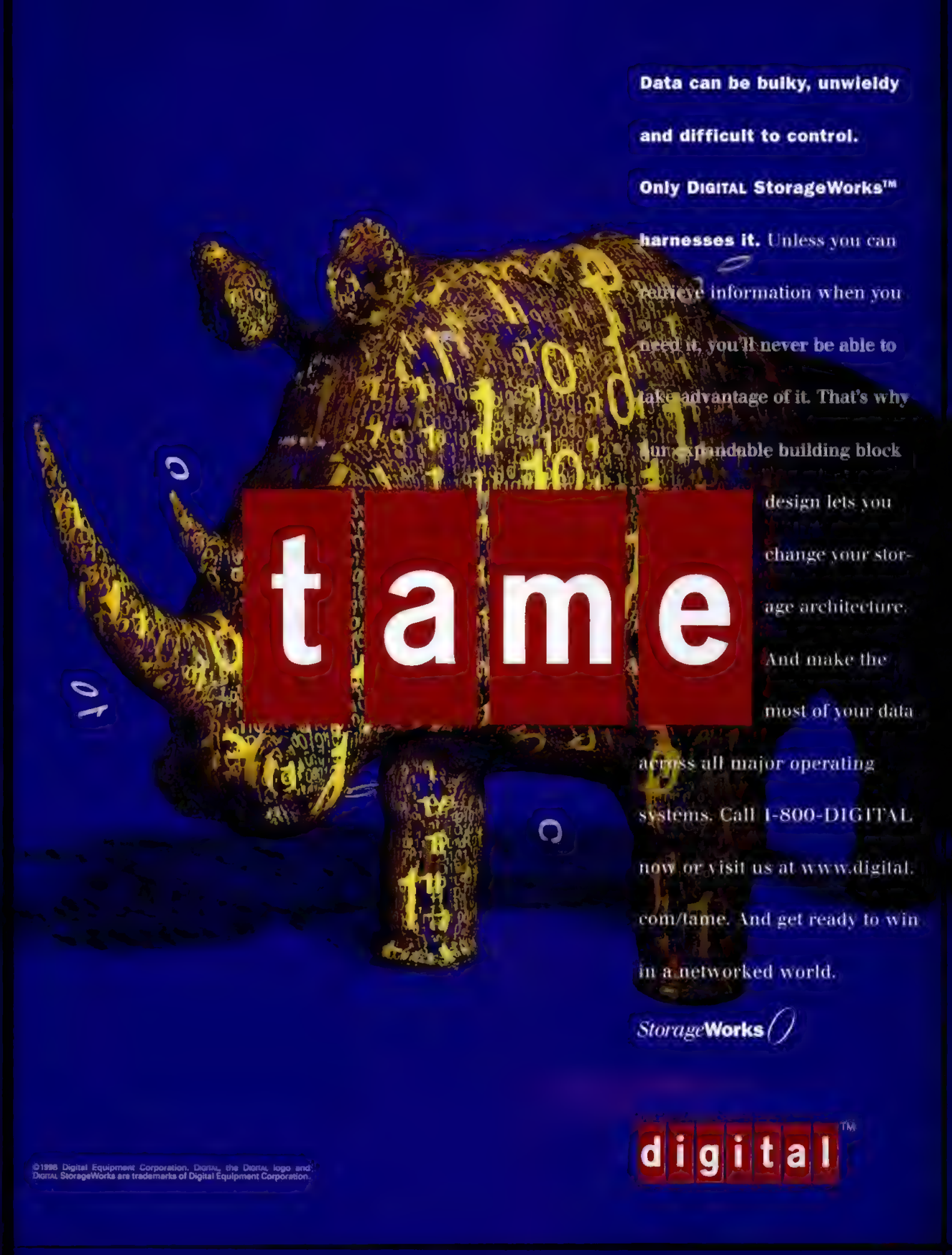
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THE Client Side OF E-MAIL

ILLUSTRATION BY ADAM McCAULEY

New e-mail products are delivering the tools to help you tame your out-of-control in-box.

By Stephen W. Plain

It used to be that an e-mail client had a simple mission: to transfer e-mail across the Internet or a proprietary system. But as the ranks of e-mail users have swelled, the emphasis on sending and receiving e-mail has given way to a more urgent challenge—managing all the messages that clog our in-boxes each day.

Many of us are deluged by not only work and personal e-mail but also by news digests, notices about software updates, and messages from mailing lists. And then, of course, there's *spam*—the electronic junk mail that has become an occupational hazard for avid e-mail users. To complicate matters further, most of us use more than one e-mail account.

Fortunately, Internet e-mail clients are stepping up to this new challenge. The products we review here include tools for managing multiple accounts, organizing messages, and creating filters that monitor incoming mail and automate routine mail chores. From simple communications programs, e-mail clients are evolving into true productivity applications that can help you work smarter and faster.

For this story, we focused on 32-bit Windows e-mail clients designed for heavy e-mail users.

IN THIS REVIEW

America Online 4.0 E-mail 113
The Bat! 113
BeyondMail Professional 116
Calypso E-mail 117
CompuServe Mail 120
email 97 128
Eudora Pro Email 4.0 128
Lotus Mail 4.52 129
MailCat 2.7 129
Microsoft Outlook 98 130
Microsoft Outlook Express 4.0 130
Netscape Messenger 4.0 151
ProntoMail Professional Edition 151
QuickMail Pro 1.5.2 153
TeamWare Embla 2.1 154
Editors' Choice 112
Free-Mail Clients 152

Editors' Choice

- E-mail only: Microsoft Outlook Express
- E-mail plus: Microsoft Outlook 98

PC MAGAZINE EDITORS' CHOICE

What a difference a year makes. Twelve months ago, Outlook was associated with an experimental hybrid struggling to compete with more established PIMs. Now, Outlook—in the form of both Microsoft Outlook Express and Microsoft Outlook 98—is setting a new standard for Internet e-mail.

Both products support the key standards, including POP3 and IMAP4, LDAP for public address lookups, and S/MIME for security. And each lets you compose messages using HTML.

But they are designed for different groups. Outlook Express, included with the free Internet Explorer 4.0, is a powerful e-mail client in its own right, but its streamlined interface and smaller feature set make it better suited to those who place more emphasis on ease of use than on power. Outlook 98 is targeted at users who want to take e-mail to another level. Its interface is more complex than that of Outlook Express, but it provides more features, including an integrated PIM.

Anyone who has used a Web browser will be comfortable using Outlook Express. The e-mail client's interface has a toolbar with large, graphical buttons for common tasks. We were impressed with Outlook Express's handling of multiple accounts and its comprehensive address-book features.

Outlook 98 begins with a robust e-mail client and adds a calendar, to-do list, a journal, sticky notes, and a new module called Outlook Today that displays unread messages and daily appointments and tasks at a glance. Other features we liked were its flexible, powerful options for sorting and grouping e-mail messages and its excellent Rules Wizard.

With the exception of the two clients for online services, America Online 4.0 E-mail and CompuServe Mail, all of the products offer sophisticated message management features, such as filters. We did not include David Harris's Pegasus Mail (*www.pegasus.usa.com*), a well-known freeware e-mail client, or TransSoft's Mail Control Pro (*www.transsoft.com*). Newer versions of both programs, not available in time for testing, may be shipping by the time you read this.

We included the AOL and CompuServe clients in our roundup for two reasons. First, millions of users rely on these services for e-mail. Second, both are moving toward offering more open standards. Our reviews show how the proprietary e-mail clients included with each service compare with standalone programs.

As our story shows, this is an excellent time to look at this category. Eudora Pro, a market leader, has recently been upgraded. But a raft of newer e-mail clients are also coming into their own, including Microsoft Outlook 98, a major upgrade to Microsoft's desktop information manager, and Microsoft Outlook Express, bundled with Internet Explorer 4.0. Many of the programs offer an impressive mix of power features.

With so many commercial, shareware, and freeware products to choose from, how do you select the right e-mail client for you? The decision depends in part on what you plan to use your account for. For example, power users will likely demand filtering tools—to make sure that the boss's messages rise to the top of the in-box—and security features. Home users may be more concerned with formatting options, such as HTML mail and the ability to handle multiple users. Some e-mail clients combine the best of both worlds and are suitable for both business and personal use.

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Visit PC Magazine Online for reviews of Internet e-mail clients that were not available in time for our story, plus an interactive summary of features.

Consider the type of e-mail system you plan to use. New users often choose an online service because it handles the setup. Both AOL 4.0 and CompuServe Mail include easy-to-use e-mail clients and, when you are ready to upgrade to a more powerful client, both will provide a path for you.

If you plan to access your e-mail through an ISP (Internet service provider), then you'll likely want an e-mail client that supports POP3 (Post Office Protocol, Version 3), the most common Internet standard for e-mail. When you use POP3, all new messages are downloaded from the server at once whenever you check your e-mail. All the standalone clients reviewed here support POP3.

About half of the e-mail clients reviewed here also support a newer standard called IMAP4 (Internet Message Access Protocol, Version 4) that enables you to access and manage e-mail on a server. For most consumers, IMAP4 is not necessary, and few ISPs currently support it. In the corporate world, however, IMAP4 is catching on, as companies seek open messaging solutions. (See "The Server Side" in this issue for reviews of IMAP servers).

Another critical area is installation and setup. Some e-mail clients can import e-mail account settings, address-book

Our Contributors: STEPHEN W. PLAIN and DAVID HASKIN are frequent contributors to *PC Magazine*. GREG ALWANG and EDWARD MENDELSON are contributing editors. E. SCOTT BARNES is a staff consultant with Walker Systems Support in Farmington, Connecticut. Long Island Internet HeadQuarters (*www.lihq.net*) and Spacelab.net (*www.spacelab.net*) provided accounts for this story. DIANE JECKER was the project leader, and JOHN MORRIS was the associate editor in charge of this story.

entries, and e-mail messages from other popular e-mail programs. But most still have far to go. Be prepared to provide your e-mail address, your POP3 or IMAP4 server address, and your SMTP (outgoing mail) server address. Your ISP or network administrator can provide all this. Several products now include wizards that help you to set up new accounts.

Other features to look for include support for HTML-formatted mail and the standard three-pane in-box window that allows you to manage folders, view the contents of a folder, and preview a selected message simultaneously. For those who receive a lot of e-mail, more sophisticated message management features, such as filters, can be critical. Essentially, they monitor incoming e-mail based on a range of criteria—text within a message, who sent it, what account it was sent from, the file size, and so on—and perform specific actions, such as sorting e-mail into folders, forwarding it, or automatically replying using message templates.

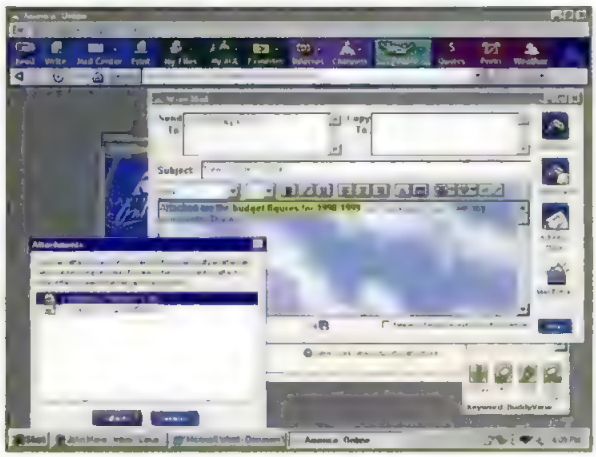
A few final features to look for are robust address books that can handle multiple e-mail addresses for each contact, mailing lists and groups, nicknames or aliases, and support for LDAP (Lightweight Directory Access Protocol). LDAP is an Internet standard that allows you to search for e-mail addresses using public directories on the Web. If security is a concern, pick a product that offers an encryption scheme such as S/MIME (Secure Multipurpose Internet Mail Extension) or PGP/MIME, a competing standard developed by Pretty Good Privacy.

Though many e-mail clients offer some combination of these features, only a handful deliver the goods in all key areas. Choose carefully, and you'll find a program that can help transform that flood of e-mail into an ally rather than an enemy.

America Online Interactive Services, a division of America Online Inc.

America Online 4.0 E-mail

The e-mail component of the world's largest online service, America Online (AOL), America Online 4.0 E-mail is a basic client that lacks many of the features found in the latest standalone e-mail clients. But it's hard to ignore a service that delivers more than 95 million e-mail messages on a good day. And what AOL 4.0 E-mail lacks in power, it makes up for in ease of use, making it an ideal choice for those first venturing online.



With 4.0 E-mail, AOL has redesigned the interface and added new mail features.

We tested a public beta of Version 4.0. The final version of the free software should be available for download or on CD-ROM close to the time you read this. AOL recently announced a rate hike to $21.95 a month for unlimited use of AOL and the Internet, beginning in April.

In the new version, AOL has revamped the interface. Borrowing a design trend from Web browsers, AOL has made the toolbar icons larger and added descriptive text below them. The buttons provide quick access to your mailbox, the Internet, and AOL's Channels.

Each AOL account includes as many as five screen names—essentially, separate e-mail addresses. With the new version, you no longer have to sign off and start a new session to switch screen names. AOL has received criticism for problems with junk mail. A new feature, Mail Controls, a host-based service accessible to members using any version of the AOL software, provides basic filters for eliminating unsolicited e-mail from selected addresses.

The built-in mail editor Write allows you to set text options such as font, color, and style (bold, italic, and underline), but only other AOL members can view messages with the formatting applied. AOL 4.0 E-mail also lets you embed images in messages. Parental controls help parents keep tabs on the in-line images.

AOL 4.0 E-mail adds a long-overdue spell-checker and a grammar checker. Another new feature lets you attach multiple files to a single e-mail message: AOL automatically compresses them.

Although AOL currently does not support such advanced features as HTML mail, MIME, and sophisticated filters, the company has announced plans to integrate technology from Microsoft Outlook Express—our Editors' Choice for consumer e-mail—into its client. Since AOL plans to add IMAP4 support to its mail servers by summer, members will soon be able to use standalone clients such as Qualcomm's Eudora Pro, Microsoft Outlook 98, and Netscape Messenger.

A no-frills e-mail client, America Online 4.0 E-mail is a quick and easy way for AOL members to keep in touch.—*E. Scott Barnes*

America Online 4.0 E-mail. Price: Free for AOL subscribers (unlimited use of AOL and the Internet, $21.95 a month). America Online Interactive Services, a division of America Online Inc., Dulles, VA; 888-265-8003, 703-448-8700; www.aol.com. *Choose 516 at www.pcmag.com/infolink.*

RITLabs S.R.L.

The Bat!

A newcomer to Internet e-mail, The Bat! ($35 direct) is a shareware program that proved a pleasant surprise on our tests. Its standard three-pane interface is easy to use and customizable. Yet it offers the power of veteran e-mail programs such as Eudora Pro. Only a few missing features kept it from joining the top tier.

Although it has no support for IMAP, The Bat! excels at managing multiple POP e-mail accounts. As in Microsoft Outlook Express, each account appears as a top-level folder with basic subfolders such as an in-box and out-box beneath it. You can create your own folders and subfolders for each account and set a wide range of parameters, such as how often the program checks for new mail and which audio alerts should be played when new mail arrives.

One feature we especially liked was the ability to select the account you want to use to send a particular message while you're working in the message composition window. Other conveniences include a drop-down list with the names of your

This isn't just a win-win situation.

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SUITABILITY TO TASK

POWER	America Online 4.0 E-mail	The Bat!	BeyondMail Professional	Calypso E-mail	CompuServe Mail	email 97	Eudora Pro Email 4.0
Installation and setup	Poor	Good	Fair	Good	Poor	Good	Good
Mail composition	Fair	Poor	Good	Fair	Fair	Good	Good
Address-book handling	Poor	Fair	Fair	Good	Fair	Good	Good
Message management	Poor	Good	Good	Good	Fair	Good	Good
Security	N/A	N/A	Fair	N/A	N/A	Good	Excellent
EASE							
Installation and setup	Excellent	Good	Excellent	Good	Excellent	Excellent	Good
Mail composition	Good	Good	Good	Good	Good	Excellent	Excellent
Address-book handling	Good	Good	Good	Good	Good	Good	Excellent
Message management	Good	Good	Excellent	Good	Good	Excellent	Good
Security	N/A	N/A	Excellent	N/A	N/A	Good	Excellent

N/A—Not applicable: The product does not have this feature.

Here we rate these Internet e-mail clients for power and ease in five categories.

Installation and setup For this category, we measure how quickly you can be up and running with each program. Features we look for include setup wizards; the ability to import settings, addresses, and mail from other programs; and support for multiple accounts and users.

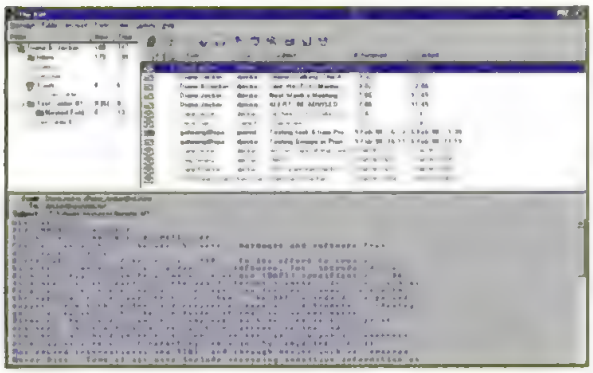
Mail composition In rating each product, we evaluate the program's options for creating and sending e-mail messages. Key features include support for HTML-formatted mail, spell-checking, a wide array of send options (such as recipient fields, delivery options, receipts, and priorities), and intuitive attachment handling.

most recent message recipients and the ability to paste the contents of the Clipboard into a message as a quotation. The Bat! also has on-the-fly spell-checking.

The Bat! is loaded with little extras. When you reply to a message, the original text message appears in a separate, scrollable window so you can refer to it. In addition, you can create templates that use variables for automatically inserting items from a pop-up menu. For instance, you can create a template that personalizes your response by placing the recipient's name in the salutation.

Our only complaints about The Bat!'s message creation capabilities are that the program doesn't support HTML, and its formatting options are basic. You can change default fonts and set font size, but you can't format individual characters and paragraphs.

The Bat!'s filters can watch for virtually any condition in the message and perform a variety of responses, including filing the message in a specific folder, responding with a form message, and adding the sender's address to your address book. Other message management features include the ability to *park* messages, which prevents you from deleting them or moving them to another folder until you unpark them. You can also set a folder to delete messages after a specified number of days.



The Bat! makes managing multiple accounts simple. Each account appears as a top-level folder in the left pane.

The Bat! has a toolbar button for PGP, but the program includes no security features of its own; you must download and install PGP separately. In addition, though we found the product to be quite usable, some may have a little trouble getting used to its nonstandard menu structure.

As its many productivity shortcuts demonstrate, The Bat! is the product of some innovative thinking. The addition of HTML mail, IMAP, and better security features could make it a real contender.—*David Haskin*

The Bat! Direct price: Individuals, $35; businesses, $45. RITLabs S.R.L., Chishinau, Republic of Moldova; 3732 246889; fax, 3732 246530; www.ritlabs.com. *Choose 526 at www.pcmag.com/infolink.*

Banyan Systems Inc.

BeyondMail Professional Internet Edition

A pioneer in e-mail filtering, Banyan Systems' BeyondMail was once a product ahead of its time. But those days are over. Although it has one of the more powerful implementations of filtering technology, BeyondMail Professional Internet Edition, Release 3 ($69 direct per seat), simply can't compete with up-and-comers such as Microsoft Outlook 98.

BeyondMail is a POP3-only e-mail client targeted toward workgroups and enterprises. Its Mailbox Wizard steps you through establishing multiple POP accounts and creating desktop shortcuts for them. Each shortcut invokes a separate instance of BeyondMail, displaying the account's folders and messages. The in-box folders are well organized, but

Lotus Mail	MailCat 2.7	Microsoft Outlook 98	Microsoft Outlook Express 4.0	Netscape Messenger 4.0	ProntoMail Professional Edition	QuickMail Pro 1.5.2	TeamWare Embla 2.1
Good	Good	Excellent	Excellent	Fair	Fair	Fair	Good
Fair	Good	Excellent	Good	Good	Fair	Fair	Fair
Fair	Excellent	Excellent	Excellent	Excellent	Fair	Fair	Good
Good	Fair	Excellent	Good	Good	Good	Fair	Good
N/A	Fair	Excellent	Excellent	Excellent	N/A	N/A	N/A
Good	Fair	Excellent	Excellent	Excellent	Excellent	Fair	Fair
Good	Good	Excellent	Excellent	Excellent	Excellent	Fair	Fair
Good	Excellent	Good	Good	Excellent	Good	Fair	Fair
Fair	Fair	Good	Excellent	Good	Good	Fair	Fair
N/A	Good	Excellent	Excellent	Excellent	N/A	N/A	N/A

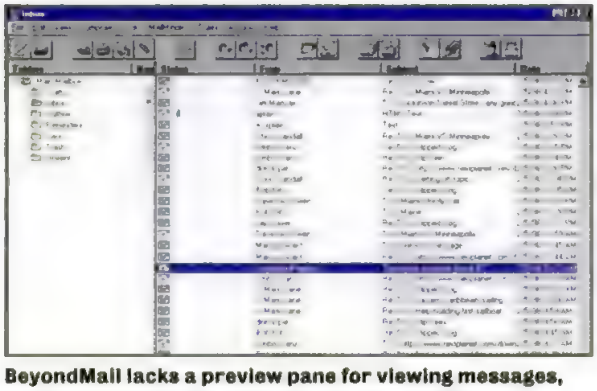
Address-book handling This category involves the program's address-book options, such as support for multiple address books, groups and mailing lists, and nicknames, and the ability to detach addresses from incoming and outgoing mail automatically.

Message management As the volume of e-mail grows, this task becomes increasingly important. Factors we evaluate here include in-box design, folder handling, filter creation tools, and search capabilities.

Security Finally, we weigh the program's support for encryption standards (S/MIME and PGP/MIME), encoding, password protection, and electronic signing.

BeyondMail has no preview pane.

BeyondMail's strength is in effectively managing large volumes of e-mail. It includes a feature called MailMinder, which comprises the Message Clerk dialog and While I'm Out screen. The Message Clerk is a user-friendly means of creating filters. You can create rules for watching for particular types of BeyondMail forms, messages from one or more individuals, priority levels, and text strings. With a few clicks, you can create rules to copy or move a message, reply to or forward it, or notify you of mail with a customized pop-up message. The While I'm Out screen gives you similar capabilities but lets you specify date ranges for each rule.



BeyondMail lacks a preview pane for viewing messages, but it offers some innovative workgroup features.

Although these features alone match some other clients' filtering capabilities, BeyondMail includes a much more powerful rule builder with its own scripting language, BeyondRules, which lets you create complex checks on message fields. The program couples this feature with the five built-in forms: Memo, Phone Message, Request Form, Meeting, and Transmittal Memo. These forms include special fields, and only other BeyondMail users can view them properly.

Despite BeyondMail's workgroup power, though, it lacks a few significant features. It doesn't support HTML mail, IMAP servers, electronic signing, or multiple signatures. The address book includes a search dialog for accessing Switchboard but is not fully LDAP-compliant.

BeyondMail also retains a proprietary feel and needs a revision to bring it up to speed with recent developments in Internet e-mail. Although some organizations will find its powerful routing and filtering attractive for in-house mail, this version is just not up to handling the rapidly changing e-mail on the Net. —*Stephen W. Plain*

BeyondMail Professional Internet Edition, Release 3. Direct price: $69 per seat. Banyan Systems Inc., Westborough, MA; 800-222-6926, 508-898-1000; www.banyan.com. *Choose 517 at www.pcmag.com/infolink.*

Micro Computer Systems Inc.

Calypso E-mail

Designed with the power user in mind, Micro Computer Systems' Calypso E-mail ($40 street) is an impressive product. This POP3 and IMAP4 client offers excellent support for multiple accounts, a highly customizable interface, powerful filtering, and auto-response features. Only a few sour notes, including lack of support for HTML mail and message encryption, kept Calypso from top billing in this category.

Calypso is tailored to users with multiple e-mail accounts, and its Mailbox Wizard guides you through the process of creating and configuring new mailboxes. You can receive mail from multiple accounts in one step and display all incoming mail in a single in-box—a major time-saver. Calypso displays the designated account name with each message, so there's no question of where the message came from.

The three-pane interface can be config-

*Offer valid through 6/30/98. Connect-time charges may apply for the Microsoft Outlook 98 messaging and collaboration client.

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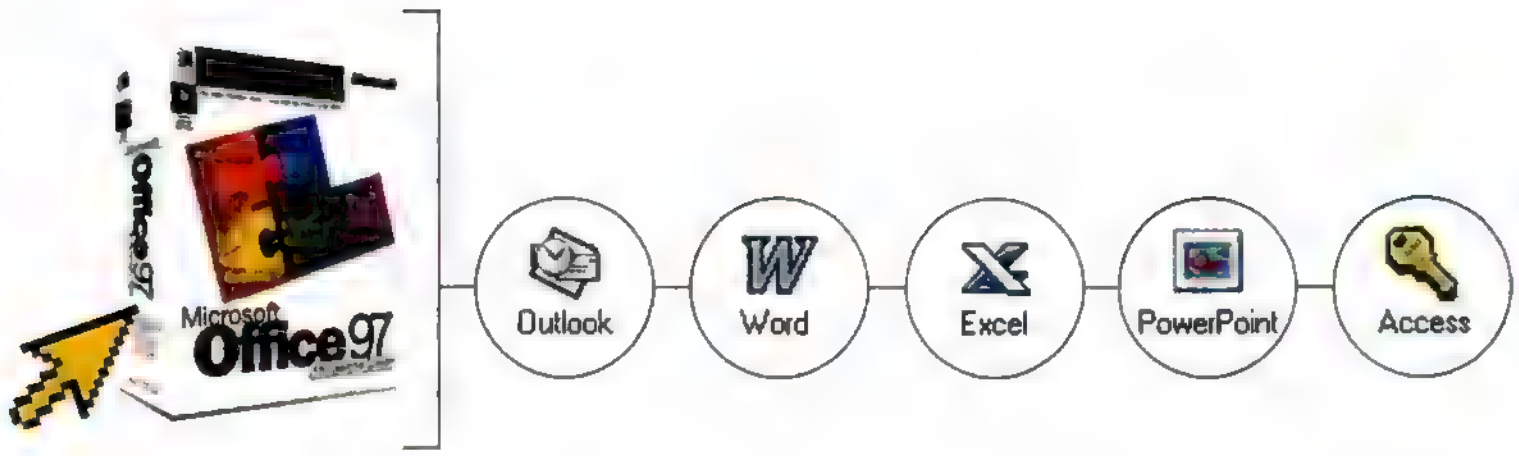


Microsoft Outlook 98.

Think of it as the integration e-mail and your mother.

From: [illegible]
Sent: Right on time
To: A remarkably pulled-together person
Subject: An e-mail application that looks after you.

With [illegible], we've raised a single, central place to take care of all the many and varied kinds of info that pour into your office every day—one place to look for e-mail, to-do lists, contact names and numbers, meetings and so on. Powerful e-mail tools let you use Outlook to presort your messages, automatically delete junk mail, and see the important stuff first. And Outlook lets you take advantage of just about any Internet server or e-mail system. The built-in calendar will find the right time for a meeting or remind you of your mom's birthday. Or, open a contact, click a button and you're ready to send e-mail. In other words, Outlook 98 takes a bunch of related tasks that once required a bunch of unrelated software and brings them together with tender, loving care. Outlook 98 is part of Microsoft Office 97—and you can download it free* at [illegible].

Microsoft

ured in a number of different layouts, depending on where you want the folder, summary, and preview panes to appear on-screen. The toolbar can float or be docked to the main dialog box, and the button icons are customizable. A clever Details dialog not only shows send and receive progress but also maintains a log of connection activity so you can diagnose problems.

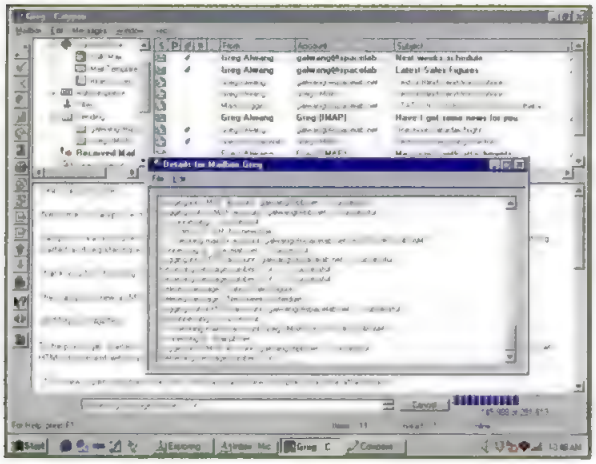
Sending basic e-mail is a breeze with Calypso's templates and signature files, but you cannot use HTML mail. Like Microsoft Outlook 98, Calypso lets you tag messages with a follow-up status, so you can keep track of open activities. You have a choice of encoding attachments using uuencoding, Base64, or BinHex, but Calypso currently does not offer encryption. An interim release should correct that by the time you read this.

The Bulk Mail option lets you create mailing lists in a text file—a useful feature for those who want to set up mass mailings without having to add all of the names to their Calypso address books. To find people or e-mail addresses, you can run compound LDAP searches based on multiple criteria.

An auto-response option lets Calypso reply to incoming e-mail with canned responses. You can use this option to inform people that you're on vacation or out of the office. In addition to basic filters for automating common tasks, Calypso includes a special filter called JunkYard that blocks spam mail based on e-mail addresses, keywords, or message subjects flagged by the user.

Calypso is a highly capable mail client with many attractive options. If the company addresses the program's few weaknesses, Calypso may soon become a player. Until then, other e-mail clients, such as Outlook 98, offer similar features and none of the drawbacks.—*Greg Alwang*

Calypso E-mail. Street price: $40. Micro Computer Systems Inc., Irving, TX; 800-886-4923, 972-659-1514; www.mcsdallas.com. *Choose 518 at www.pcmag.com/infolink.*



Calypso displays messages from multiple accounts in the in-box with the designated account's name.

CompuServe Interactive Services Inc.

CompuServe Mail

Recently acquired by America Online Inc., CompuServe has retained a loyal following of people drawn to the online service by its extensive discussion forums. Its e-mail client—CompuServe Mail—is not nearly such hearty fare, but new services such as POP3 support are giving members more options. To those who have CompuServe accounts or are attracted by the service's many other offerings, we recommend taking advantage of the POP3 option and using a standalone e-mail client such as Microsoft Outlook Express or Outlook 98.

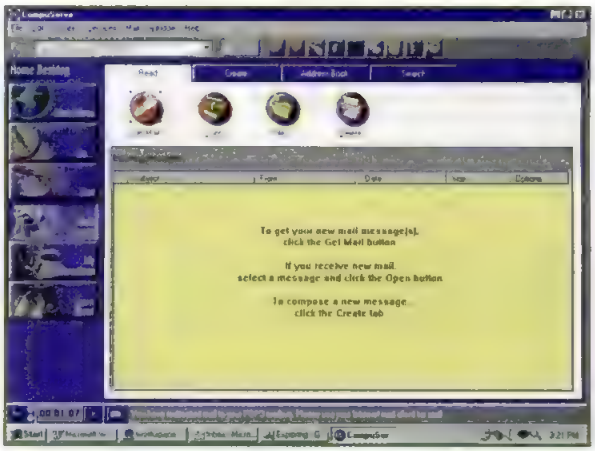
The free CompuServe Mail is available on CD-ROM only; monthly subscriptions to the online service cost $24.95 for unlimited usage. (AOL will retain CompuServe as a separate service.) The next version of the software is due out by the end of this year.

The installation program has a multimedia sequence that walks you through installing the program files and the included Microsoft Internet Explorer 3.0. Then a wizard helps you set dialing options, select local access numbers, and configure your modem.

Although it is not as easy to use as America Online 4.0, CompuServe Mail has big, bright buttons that let you navigate the vast service relatively easily. By clicking on the Mail Center button, you can open a dialog box with simple instructions on how to compose, send, and retrieve mail.

CompuServe is quite limited as an e-mail client. It doesn't support rich text, HTML-formatted mail, digital IDs, or encryption. Although you can create custom folders and set default locations for incoming and outgoing mail, CompuServe provides no filters and, in contrast to AOL, no special features for blocking junk mail.

Since December, CompuServe has offered POP3 support in addition to its proprietary mail system. To use POP3 mail, CompuServe Mail users must first make their mailboxes into POP3 boxes (type GO POPMAIL). CompuServe walks you through the process of creating a new mailbox (at *username@csi.com*) and redirecting your mail to that account.



CompuServe's e-mail client is graphical and easy to use, but its features are limited.

Once you've switched your mailbox to POP3, you can then use any Internet e-mail client, such as Qualcomm's Eudora, Microsoft Outlook Express or Outlook 98, or Netscape Messenger. CompuServe even provides step-by-step instructions on how to configure many of the most popular e-mail clients, so you'll be up and running in no time.

CompuServe's e-mail client is easy to use but otherwise unremarkable. If you find the service's other offerings enticing, however, you can always use your favorite POP3 e-mail client to access your CompuServe account.—*ESB*

CompuServe Mail. Price: Free for CompuServe subscribers (unlimited use of CompuServe, $24.95 a month). CompuServe Interactive Services Inc., Columbus, OH; 800-848-8199, 614-457-8600; www.compuserve.com. *Choose 519 at www.pcmag.com/infolink.*

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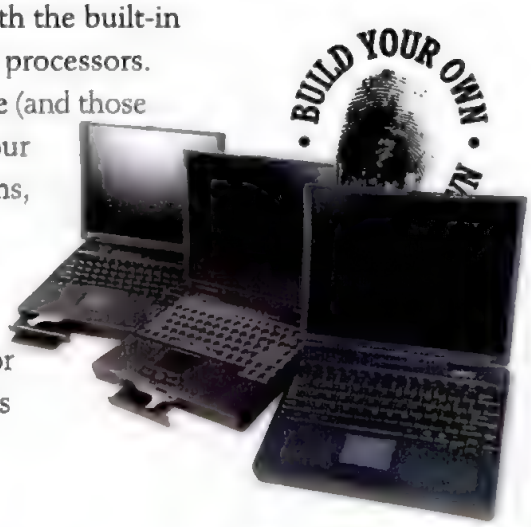

Pictured left to right: Solo 9100, 5100 and 2300 PCs.

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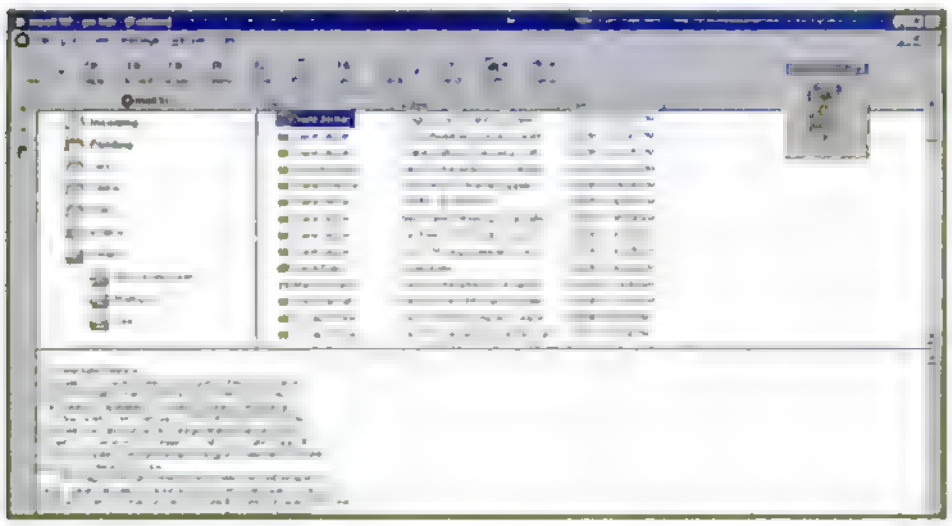
E Corp.

email 97

E-mail has been around a long time, and most e-mail clients have similar feature sets. But not E Corp.'s email 97. The program ($35 street) offers such novel features as paging, the ability to preview messages on POP3 servers (a feature typically associated with IMAP servers only), built-in language translation, and calendaring and scheduling. But email 97 did not fare as well as its competitors in core areas.



With email 97, you can create custom folders, but they must be nested under a Folders folder.

The program's main interface consists of a typical three-pane dialog box that allows you to preview messages and organize them in folders. You can create nested folders, but email 97 forces you to organize all of them within a designated folders Folder.

Like Micro Computer Systems' Calypso, email 97 can manage multiple POP3 accounts and deliver all messages to the same incoming-mail folder or to different folders. A preview feature lets you selectively download or delete POP mail.

By contrast, we found email 97's IMAP support to be quite limited. The program works only with a single IMAP account and, in our tests, we were unable to download messages selectively from the server or create server-side folders. Every time we highlighted the IMAP in-box, email 97 retrieved all of the messages.

One of email 97's most interesting features is its vertical toolbar, eTelligence. When you send mail to the same address on a regular basis, email 97 suggests that you add a button for that recipient to the toolbar. You can also create new ebuttons using plain English phrases (albeit very carefully constructed ones). The feature worked well when used for designating ebuttons for frequently used addresses but not as well for creating more complex filters. Inevitably, we wound up in the filter dialog, where you must tweak the filter instructions by hand.

Each email 97 filter can have three separate actions. The program gives you a good selection of actions to choose from, including forwarding, translating, paging, and filing. Another dialog lets you specify certain days and hours for each filter. Email 97 can automatically dial numeric and alphanumeric pagers on any of 17 paging service providers or any service with Internet paging.

For e-mail users with international correspondents, email 97 offers a built-in translator for converting to and from English and any of five languages (French, German, Italian, Portuguese, and Spanish). The calendar module lets you create e-mail and pager reminders for meetings and other events.

E Corp.'s email 97 has unique features that may appeal to certain users. With improved IMAP support, this product could compete with the top programs in this catagory.—*SWP*

email 97. Street price: $35. E Corp., Pittsburgh; 888-326-7748, 412-921-2100; www.e-corp.com. *Choose 520 at www.pcmag.com/infolink.*

Qualcomm Inc.

Eudora Pro Email

A veteran program, Eudora is one of the most popular e-mail clients on the Internet. Not surprisingly, the latest version, Eudora Pro Email 4.0 ($40 street), is a mature and powerful POP3 and IMAP4 client. Nevertheless, newer products have overtaken Eudora in some areas.

Designed for heavy-duty mail users, Eudora Pro easily handles multiple accounts. A vertical pane on the left displays the folders for all accounts and contains tabs to view nested folders, stationery, signatures, and accounts. As you open folders, the headers appear to the right and a window below displays a preview of each message.

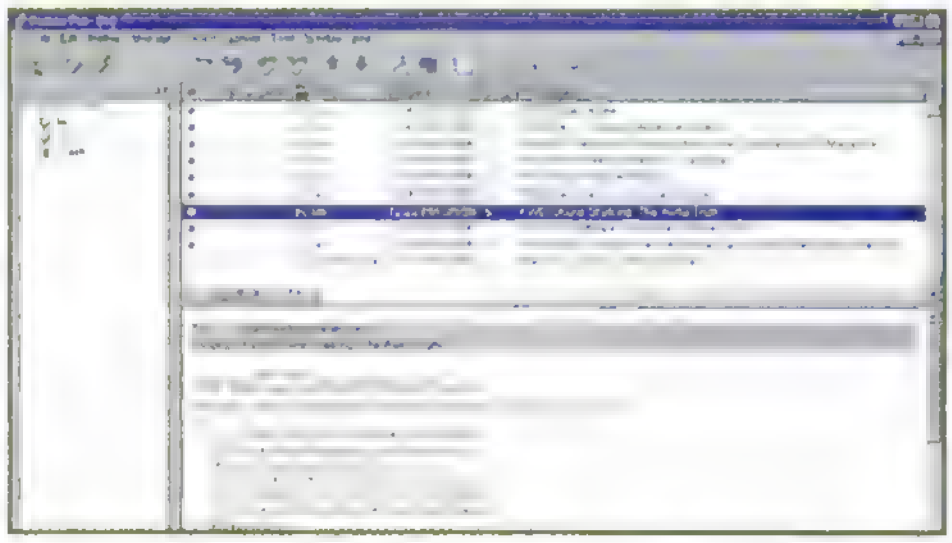
To check all your accounts at once, you can configure Eudora to retrieve all mail when you click the Check Mail toolbar button. Eudora does not check for mail in the background, as Microsoft Outlook 98 and Outlook Express do, so you must wait until the chore is completed before resuming your work.

Eudora offers capable filtering tools. You can apply filters to incoming and outgoing mail automatically or manually by folder. Each filter can have as many as two criteria based on various message fields, and you can join them with Boolean operators. You can select as many as five actions, including several notification options. A unique Make Filter feature creates filters quickly based on a selected message.

The filter dialog is part of a tabbed window that also includes a filter log, an address book, and directory services. Eudora comes configured for all of the popular LDAP and other public directories, supports the protocol Finger, and allows you to define new databases easily.

Although Eudora's mailbox handling and filters were easy to get used to, we had less success with the search features. The only way to search for a message in Eudora is via a basic Find/Find Next dialog box. Rather than skimming a list of matches to locate the message you're looking for quickly, you must manually page through every match in sequence from most to least current.

Eudora Pro Email 4.0 comes with a licensed version of Network Associates' VirusScan 3.0, Pretty Good Privacy 5.5, Verity's KeyView, Aladdin Systems' StuffIt, and Qualcomm's PureVoice Player-Recorder, a utility that lets you embed compressed voice attachments within messages.



Eudora Pro's in-box displays all of your POP3 and IMAP4 accounts in a single location.

Eudora Pro Email 4.0 is an evolutionary product. Some current users will want to upgrade, but others will find new packages, such as Outlook 98, that offer the same features and more.—*SWP*

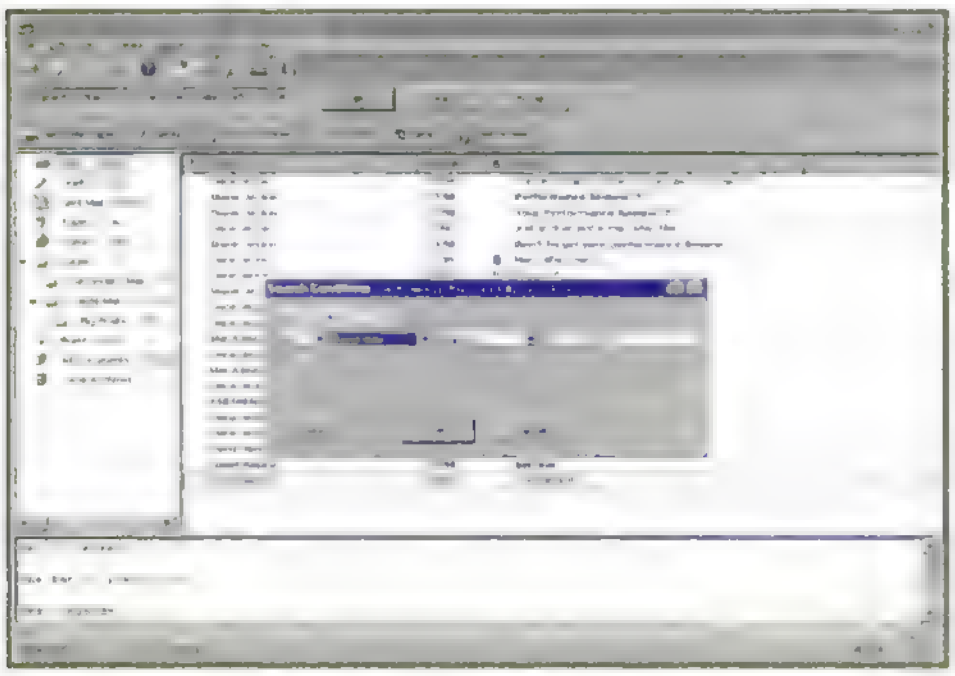
Eudora Pro Email 4.0. Street price: $40. Qualcomm Inc., San Diego; 800-238-3672, 619-658-1291; www.eudora.com. *Choose 500 at www.pcmag.com/infolink.*

Lotus Development Corp.

Lotus Mail

A bridge between the Lotus of old (cc:Mail) and the Lotus of the future (Notes and Domino), Lotus Mail, Version 4.52 is a basic Internet e-mail client that feels a lot like cc:Mail. Though it is a capable POP3 e-mail client, Lotus Mail ($35 street) lacks advanced features such as HTML-formatted mail and digital signatures. Lotus has no plans for an upgrade—Domino 5.0 will replace both Lotus Mail and cc:Mail—but Lotus Mail is nevertheless significant as an intermediate step that can smooth the migration from cc:Mail to Domino.

The first thing you notice about Lotus Mail is that its interface is strikingly similar to that of cc:Mail. This is an advantage for those familiar with cc:Mail. But when compared with newer e-mail clients, Lotus Mail shows its age. Though it has a three-pane view, it lacks the graphical look and feel of Microsoft Outlook Express, for instance, and offers none of the interface customization of Qualcomm's Eudora or Micro Computer Systems' Calypso. More significant, Lotus Mail lacks wizards for setting up mail accounts, creating filters, and searching for messages.



Lotus Mail looks a lot like cc:Mail. Its search features are impressive.

Despite the lack of wizards, installation and setup was a breeze on our tests. Lotus Mail found and imported an existing Microsoft Outlook 97 profile.

During installation, you can choose whether or not to install LDAP support. The program's LDAP implementation proved awkward in our testing. For example, when we specified an unknown address while composing a message, Lotus Mail immediately performed an LDAP server search and suspended all other activity until it was completed. Since the search cannot be canceled, it can tie up your PC for several minutes.

New users will like the way Lotus Mail's large buttons facilitate composing, replying to, and delivering mail. The search features are more difficult to find, because the Search Bar is hidden by default. But once you find the search options, you'll discover they are quite good. You can perform Boolean searches on one or all folders and search for attachments by name.

With no support for HTML-formatted mail, Lotus Mail limits you to only the most basic formatting options, though you can create e-mail templates. A useful type-ahead feature speeds up e-mail addressing, and the program can automatically add addresses in outgoing mail to your address book.

Like cc:Mail, Lotus Mail includes relatively powerful filtering options. You can create compound rules that store, forward, and delete messages, play audio alerts, or execute other programs.

Lotus is staking its e-mail future on Domino, and Lotus Mail is just a stop along the way. As an interim solution, Lotus Mail has advantages. But as a standalone client, it can't compete with the top products in this roundup.—*GA*

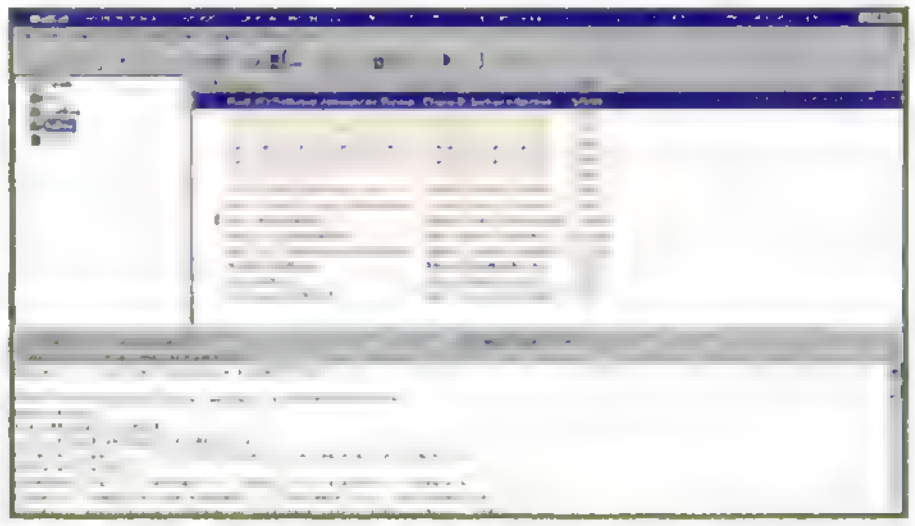
Lotus Mail 4.52. Street price: $35. Lotus Development Corp., Cambridge, MA; 800-343-5414, 617-577-8500; www.lotus.com. *Choose 512 at www.pcmag.com/infolink.*

Black Paw Communications

MailCat

An Australian import, MailCat ($45 list) is full of contradictions. The version we tested, Version 2.7, offers lots of power features, yet it is missing some of the basics. Although MailCat includes some nice options that simplify message composition, other parts of the interface can be puzzling.

Setting up MailCat is a no-brainer, thanks to its Account Setup wizard. It imports Eudora address books and text files. MailCat employs the familiar three-pane interface with a message preview.



MailCat has a clean, three-pane interface and a built-in folder for filtering spam.

You can configure MailCat to check periodically for mail in any account. System tray icons allow you to create new messages quickly and send and retrieve mail, although it would help minimize clutter if all the options were accessible from a single system tray icon. The same dialog box used for adding and managing addresses and groups also lets you create additional address books.

MailCat's message composition skills are especially strong. The editor closely resembles a word processor, with buttons and drop-down lists for selecting fonts, font sizes, and other formatting options. Another drop-down list lets you choose a signature. You can create messages in HTML and include embedded images in a variety of formats. MailCat also has a spell-checker and supports encryption.

MailCat's Spam Doctor is a specialized filter that automatically routes messages that, for example, have a specific number of exclamation points in the subject line to a spam cabinet. The program's other filters, however, are a mixed bag. They can respond to incoming messages in many ways, such as sending canned messages, moving messages

to a folder, and running specific programs. But the filters can look for specific text in the incoming messages only and not for other factors, such as message size and the account that received the mail.

MailCat does not support IMAP, but it can scan POP3 servers and display the headers of incoming mail. You then can download only the messages you want, hold other messages on the server, and delete others without downloading them.

During testing, we found some elements of MailCat's interface to be confusing. For instance, the in-box has columns for the subject, from/to, message priority, and attachments but not for file size. MailCat's method for handling file attachments is awkward. And printing options are located at the top of the File menu. These are minor gripes, but they are enough to make MailCat frustrating to use, at times.

MailCat is a reasonably powerful e-mail client. But it could use a face-lift to make it competitive with the category leaders.—*DH*

MailCat 2.7. List price: $45. Black Paw Communications, Brisbane, Australia; 800-242-4775, 404-779-4017; www.blackpaw.com. *Choose 522 at www.pcmag.com/infolink.*

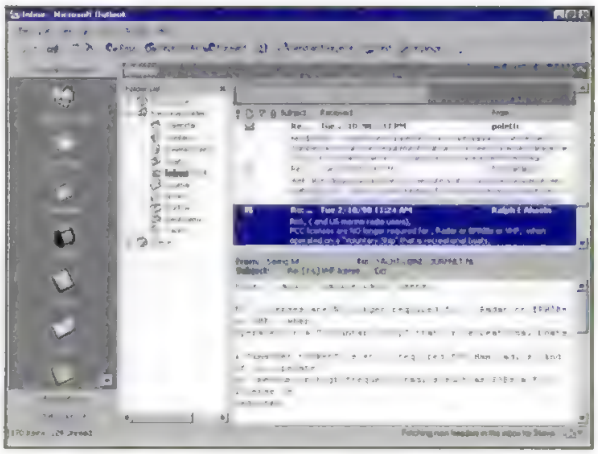
Microsoft Corp.

Microsoft Outlook 98

PC MAGAZINE EDITORS' CHOICE

After a somewhat rocky start, the outlook for Microsoft's combination e-mail client and PIM is very good indeed. In Microsoft Outlook 98, Microsoft has retooled the program's e-mail capabilities, creating the most powerful e-mail client we've seen to date. Outlook 98 offers support for every standard under the sun, the most flexible interface, the most powerful folder management, and comprehensive yet easy-to-use message filtering. These features make Outlook 98 the best choice for power users, especially business users who can take advantage of its PIM functionality.

We tested the second public beta of Outlook 98. The final version should be available by the time you read this. It will be a free download for a limited time, after which it will cost $110 (street). Registered users of Microsoft Office 97 can upgrade for free.



Microsoft Outlook 98's AutoPreview displays the first few lines of every message in your in-box.

Described as a desktop information manager, Outlook 98 merges e-mail with a calendar, contact manager, task list, journal, and sticky-note pad. The newest component is Outlook Today, a single screen that shows at a glance your appointments and tasks for the upcoming one to five days, as well as the status of your e-mail in-box. A search field lets you quickly retrieve contact records.

The folder views in Outlook 98's Inbox are highly customizable. You can configure all of the columns (Subject, Date, Priority, and so on). The program includes several logical, ready-made views, including the most recent seven days' mail, unread mail, and mail organized by sender and by addressee. The program even has a timeline view that lets you scan e-mail graphically based on date. AutoPreview, a highly useful feature, displays the first three lines of each message under its header.

The most useful feature is the program's drag-and-drop message grouping. You can group and view messages based on any viewable message field by simply dragging the field to the top of the in-box.

Outlook 98 takes a new approach to message filtering that gives you a powerful tool for combating e-mail overload. Rules Wizard steps you through the process of building filters using plain-English statements. The wizard permits almost any combination of criteria, and it made short work of our test filters. Outlook 98 also includes built-in features for flagging incoming mail as junk e-mail or adult-oriented mail.

Outlook 98's message editor is well designed and full-featured, but you also can opt to use Word 97. Like Microsoft Outlook Express 4.0, Outlook 98 includes HTML-based stationery and support for LDAP and S/MIME.

E-mail is only one of Outlook 98's functions. Yet it manages e-mail so well that Outlook 98 is the product of choice for Internet e-mail on this basis alone. Its other capabilities are icing on the cake.—*SWP*

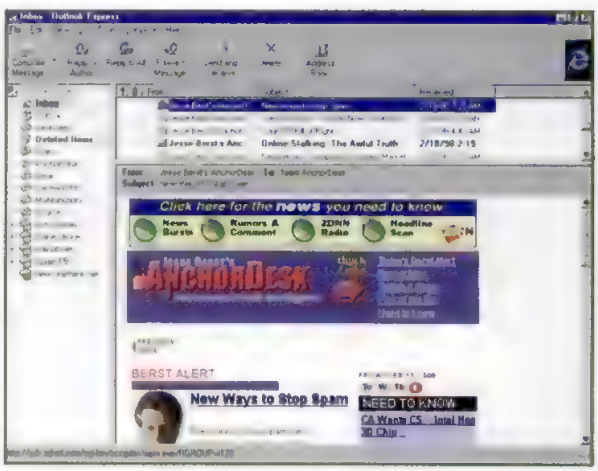
Microsoft Outlook 98. Street price: $110 (free download for a limited time). Microsoft Corp., Redmond, WA; 800-426-9400, 425-882-8080; www.microsoft.com. *Choose 513 at www.pcmag.com/infolink.*

Microsoft Corp.

Microsoft Outlook Express

PC MAGAZINE EDITORS' CHOICE

Who says there's no such thing as a free lunch? If you're using the free Microsoft Internet Explorer 4.0 as your Web browser, you already have one of the best e-mail clients available. Microsoft Outlook Express 4.0, bundled with IE4, lacks the more complex filters and added PIM functionality of Outlook 98, yet beneath Outlook Express's friendly face is a surprisingly powerful e-mail client, making it a great choice for consumers.



Microsoft Outlook Express looks like a Web browser. Its HTML mail support is excellent.

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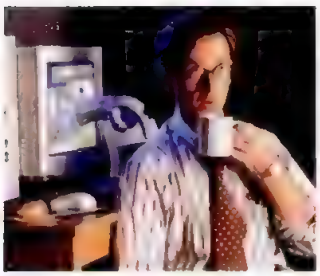
Windows Magazine, 8/97

Overall rankings
Technical Support Survey

PC VENDOR	GRADE
Quantex	Excellent
Dell	
IBM	
Compaq	Good
Gateway 2000	
Micron	
Acer	Fair
Toshiba	
Digital	Poor
Packard Bell	

Windows Magazine, 8/97



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Computer Shopper
1997 Direct Channel Achievement Award for Systems

PC Computing
1997 Most Valuable Product: QP6/266 SM-4x

PC Magazine
Editor's Choice Award QP5/233 M-3 (12/97)

PC World
11 Best Buy Awards Oct '97 - Mar '98

MMX intel inside pentium® II processor

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Business lease: $53/Mo.

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- Choice of Intel Pro 100 Ethernet Controller with Wake-On-LAN™ Technology or K56flex protocol Fax/Modem*
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- Quantex ATX Mid Tower Case
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- Quantex ATX Mid Tower Case
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- 512KB Pipelined Burst Cache
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- **24X Modular CD-ROM Drive**
- PCI Bus with 128-bit graphics accelerator
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H-1210 w/233MHz Pentium processor w/MMX Technology $1999

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(with MMX™ Technology)

Business lease: $102/Mo.

266MHz Pentium® processor with MMX™ Technology
- Intel Mobile Module (I.M.M.) Architecture
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- Integrated 16-bit Stereo Sound and Speakers
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QP6/266 SM-4x SE(with Pentium II processor). $2399
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SUMMARY OF FEATURES

E-Mail Clients

■ YES ▨ NO	America Online 4.0 E-mail	The Bat!	BeyondMail Professional Internet Edition, Release 3	Calypso E-mail	CompuServe Mail	email 97	Eudora Pro Email 4.0	Lotus Mail
General Features								
Price	Free for AOL subscribers	Individuals, $35 direct; businesses, $45 direct	$69 direct	$40 street	Free for CompuServe subscribers	$35 street	$40 street	$35 street
Protocols supported:								
POP3/SMTP/IMAP4	▨ ▨ ▨	■ ■ ▨	■ ■ ▨	■ ■ ■	■ ▨ ▨	■ ■ ■	■ ■ ■	■ ■ ▨
LDAP	▨	▨	▨	■	▨	■	■	■
S/MIME / PGP/MIME encryption	▨ ▨	▨ ■	▨ ▨	▨ ▨	▨ ▨	▨ ■	▨ ■	▨ ▨
MIME/Uuencoding	■ ■	■ ■	■ ■	■ ■	▨ ▨	■ ■	■ ■	■ ▨
Supports multiple users or profiles without users exiting	■	■	▨	■	▨	■	■	■
Can retrieve mail from multiple accounts in the same session	■	■	▨	■	▨	■	■	■
Can schedule automatic mail retrieval	■	■	■	■	▨	▨	■	■
E-Mail Composition								
Integrates with third-party editors	▨	▨	▨	▨	▨	▨	▨	▨
Supports multiple fonts/font sizes/styles	■ ■ ■	▨ ▨ ▨	■ ■ ■	■ ■ ■	▨ ▨ ▨	■ ■ ■	■ ■ ■	■ ■ ■
User can view/format HTML mail	▨ ▨	▨ ▨	▨ ▨	▨ ▨	▨ ▨	■ ■	■ ■	▨ ▨
Preserves live URLs in messages	▨	■	■	▨	▨	■	■	▨
Includes e-mail templates	■	■	■	■	▨	■	■	■
User can create custom templates	▨	■	■	■	▨	■	■	■
Built-in spell-checker/grammar checker	■ ■	■ ▨	■ ▨	■ ▨	▨ ▨	■ ▨	■ ▨	■ ▨
Supports in-line images	■	▨	■	▨	▨	■	■	▨
Compresses outgoing e-mail	▨	▨	▨	▨	▨	■	▨	▨
File attachments:								
Attachments displayed in message body	▨	■	▨	▨	▨	▨	■	■
Multiple attachments with one message	■	■	■	■	■	■	■	■
Compresses attachments	■	▨	▨	▨	▨	■	▨	▨
Password-protects attachments	▨	▨	▨	▨	▨	▨	■	▨
Supports multiple signature files	▨	■	▨	■	▨	■	■	■
Can quote message history	■	■	■	■	▨	■	■	■
E-Mail Management								
Can preview headers in in-box	■	■	▨	■	■	■	■	■
Can preview message text in in-box	▨	■	▨	■	▨	■	■	■
Displays the number of new or unread messages	▨	■	■	■	■	■	■	■
In-box icon for messages with attachments	■	■	■	■	▨	■	■	■
Supports nested folders	■	■	■	■	▨	■	■	■
User can drag and drop between folders locally/on the server	■ N/A	■ N/A	■ N/A	■ ▨	■ N/A	■ ▨	■ ■	■ N/A
Can search for text/perform Boolean searches	■ ▨	■ ■	■ ■	■ ▨	■ ▨	■ ▨	■ ▨	■ ■
Imports address books from other e-mail clients	▨	▨	▨	■ (Eudora)	▨	■ (Email Connection, Eudora, Netscape)	■ (cc:Mail, MS Outlook Express, Netscape, QuickMail)	■ (Eudora, MS Outlook)
Supports multiple/shared address books	▨ ▨	■ ▨	■ ■	▨ ▨	▨ ▨	▨ ▨	■ ■	▨ ▨
Automatically inserts addresses from incoming/outgoing mail in address book	▨ ▨	▨ ▨	▨ ▨	■ ■	■ ▨	■ ■	▨ ▨	■ ▨
Supports aliases or nicknames/favorites	▨ ▨	■ ■	■ ▨	■ ■	■ ▨	▨ ■	■ ■	■ ▨
Can filter incoming mail based on:								
Sender/Subject	▨ ▨	■ ■	■ ■	■ ■	▨ ▨	■ ■	■ ■	■ ■
Message text/File size	▨ ▨	■ ■	■ ▨	■ ▨	▨ ▨	■ ■	■ ■	■ ■
Filter for sorting/automatically replying	▨ ▨	■ ■	■ ■	■ ■	▨ ▨	■ ■	■ ■	■ ■
Filter for launching programs	▨	■	■	■	▨	■	■	■
Other filter types	Mail Controls (blocks junk e-mail)	Delete	MailMinders, BeyondRules (a scripting language)	Redirect, alert, save to file, run another filter, save attachment	None	Delete, print, forward, redirect, others	16 additional filters	Delete, forward, copy to folder, print, others

(1) This feature is available when Microsoft Word 97 is used as the e-mail editor. (2) This product has an auto-preview for the first lines of a message. N/A—Not applicable: The product does not have this feature.

See www.pcmag.com for interactive views

MailCat 2.7	Microsoft Outlook 98 (PC MAGAZINE EDITORS' CHOICE)	Microsoft Outlook Express 4.0 (PC MAGAZINE EDITORS' CHOICE)	Netscape Messenger 4.0	ProntoMail Professional Edition	QuickMail Pro 1.5.2	TeamWare Embla 2.1
$45 list	$110 street; download, free for a limited time	Free with IE4	Free with Netscape Communicator	Free download	$60 street	$49 list; download, $39 direct
■■■	■■■	■■■	■■■	■■■	■■■	■■■
■	■	■	■	■	■	■
■■	■■	■■	■■	■■	■■	■■
■■	■■	■■	■■	■■	■■	■■
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††Performance will vary when using 1GB cartridges.

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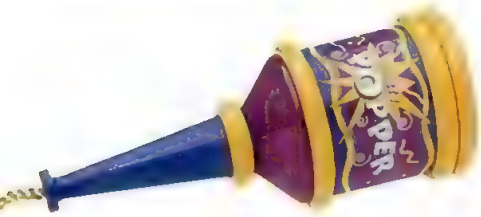

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features, you'll find that Outlook Express more than fills the bill.—*SWP*

Microsoft Outlook Express 4.0. Price: Free, bundled with the Microsoft Internet Explorer 4.0. Microsoft Corp., Redmond, WA; 800-426-9400, 425-882-8080; www.microsoft.com. *Choose 513 at www.pcmag.com/infolink.*

Netscape Communications Corp.

Netscape Messenger

The e-mail client integrated with the free Netscape Communicator browser suite, Netscape Messenger 4.0 is a full-featured program that supports all of the major Internet standards and offers an integrated news reader. Its best features are an intuitive and powerful IMAP implementation, tight integration with Netscape Navigator, and comprehensive LDAP support. But Messenger is lacking in other important areas. Designed largely for business users, Messenger will appeal most to Navigator loyalists and organizations that have standardized on Communicator for open messaging.

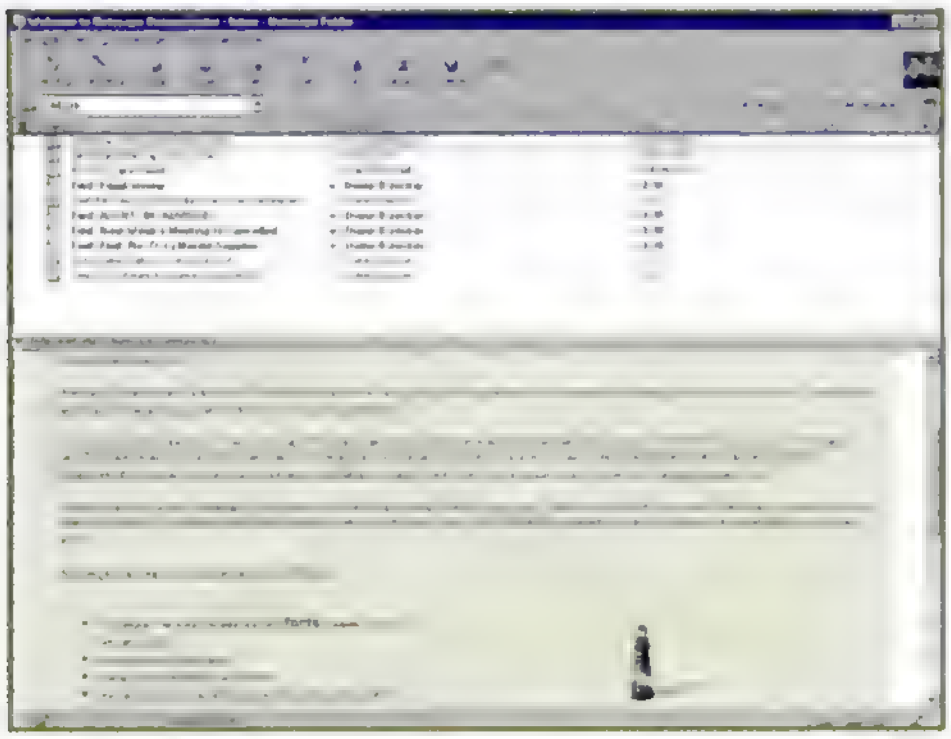
Like the other components of Communicator, Messenger asks you to choose a profile when you start up. The Profile Manager is separate so, to switch profiles, you must exit and relaunch Messenger. Each profile supports just one e-mail account, so you must exit the program several times to check multiple mailboxes.

Messenger's interface closely resembles the familiar Navigator browser, complete with its own navigation toolbar. As you scroll through the message headers in a folder, Messenger displays a preview of the selected message. But it does not include the standard folders view, and you cannot drag and drop messages. Instead, you view the folders in a drop-down list.

Messenger supports both POP3 and IMAP4. On our tests, it managed IMAP accounts seamlessly. We were able to create a profile for our IMAP account and work with it in almost exactly the same way as with any POP account. We created folders on the server and were able to retrieve message headers, bodies, and attachments selectively. In addition, Messenger was the only product that allowed us to create filters for IMAP mail.

Not surprisingly, Messenger's HTML support is excellent, and the program supports a broad range of encoding standards. Messenger's LDAP support includes the ability to perform complex LDAP searches using fields such as city and street address and operators such as *Name contains.*

Messenger's filtering tools are more limited. The dialog box in which you construct filters is straightforward. You can set as many as five criteria for incoming mail. Each filter can trigger up to six basic actions. By contrast, Outlook Express allows you to filter mail based on the sender or the account it was sent to, and you can automatically reply to or forward messages.



Netscape Messenger's in-box is well-designed and easy to use, but it cannot display multiple accounts simultaneously.

Messenger's major drawbacks are its weak support for multiple users and accounts and its limited filtering. In business settings where these may not be significant concerns, Messenger is worth a look.—*SWP*

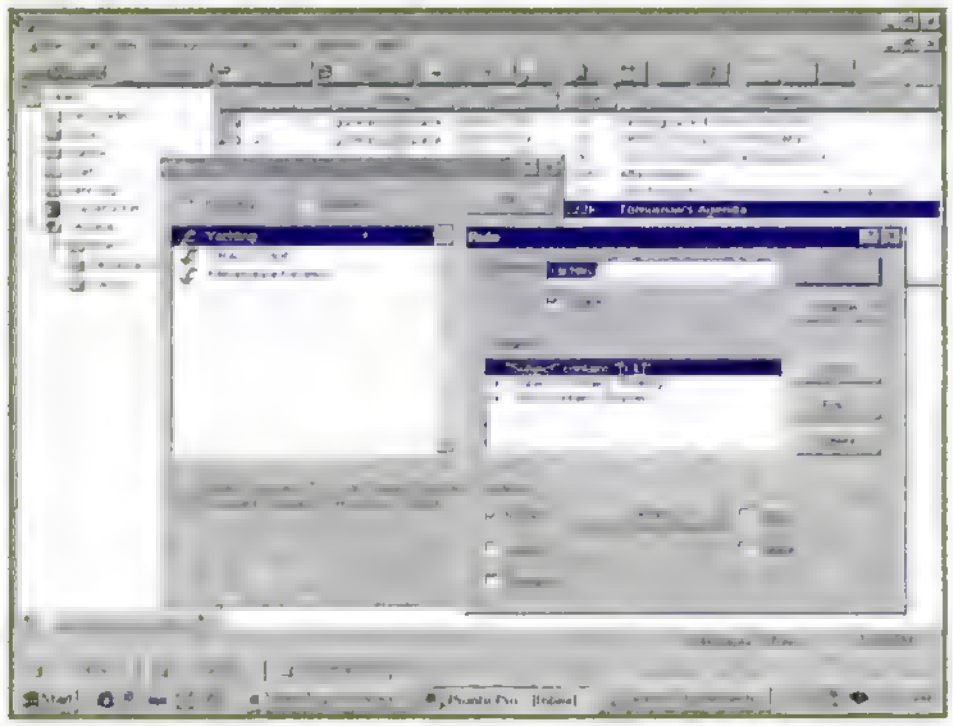
Netscape Messenger 4.0. Price: Free with Netscape Communicator, Standard Edition. Netscape Communications Corp., Mountain View, CA; 800-638-7483, 650-254-1900; www.netscape.com. *Choose 514 at www.pcmag.com/infolink.*

CommTouch Software Inc.

ProntoMail Professional Edition

ProntoMail Professional Edition (free download) from CommTouch Software is a basic POP3 client that supports filters, multiple address books, and signature files. But the product lacks some higher-end features, such as multiple account support and encryption. A former Editors' Choice product, ProntoMail is a capable e-mail client, but others have overtaken it.

ProntoMail is generally easy to install, but on our tests, it did not ask for the SMTP server address during installation. We had to set this option in the advanced mailbox settings after launching the program for the first time.



Pronto Pro's Rules Manager lets you combine multiple criteria using Boolean operators to filter incoming and outgoing mail.

ProntoMail has a standard interface, with the folder view on the left and message header and preview views to the right. Large buttons point you to areas for composing, replying to, forwarding, and sending mail, and you can easily find the features you're looking for on the program's menus. Those unfamiliar with e-mail will feel like seasoned pros in no time.

But the simplistic design of ProntoMail sacrifices some advanced features. For instance, ProntoMail supports only one POP3 account, and you cannot use HTML-formatted mail. You can, however, search on multiple message fields or date ranges. And ProntoMail's filters were comprehensive, allowing you to combine criteria and use Boolean operators.

In addition to ProntoMail Professional Edition, CommTouch offers Fam-

Free-Mail Clients

Don't have an e-mail account? You can still take advantage of e-mail by using any of these (mostly) free and (mostly) browser-based mail services. One of the greatest benefits of these Web-based services is that you can access your e-mail using any PC.—*By Edward Mendelson*

★★★★★—Best	**AOL NetMail** America Online Inc. (*www.aol.com*)	**Friendly Email** InTouch Software Inc. (*www.intouch-software.com*)	**Hotmail** Microsoft Corp. (*www.microsoft.com*)	**iName** iName Inc. (*www.iname.com*)
Other sites where the service is implemented	None	*www.friendlyemail.com, www.mypad.com*	*www.hotmail.com, www.msn.com*	*www.geocities.com, www.infospace.com, www.lycos.com, www.netscape.com, www.pathfinder.com, www.switchboard.com*
Setup	★★★★★ You can use the service only if you already have an AOL account. No extra setup is required.	★★★★ The sign-up procedure is very simple. You can choose among a variety of domain names, such as MyPad.com, for your address.	★★★★ The questionnaire is reasonably simple. No phone number is requested.	★★★★ The questionnaire asks for your phone number but doesn't inflict a marketing survey on you.
Interface	★★★ Basic, easy, and better than the similar one in AOL's proprietary software, with tabs for new, old, and sent mail. And you don't have to wade through ads to get there.	★★ Extremely basic but easy to navigate.	★★★★ Rich in information (such as breaking news) but cluttered and graphics-heavy, which slows loading. The message list doesn't indicate which messages have attachments.	★★★ Graphics-heavy and somewhat slow but easy to navigate.
Message creation/receipt	★★ Unlike AOL mail, AOL NetMail has no formatting features or in-line graphics, but you can send and receive file attachments. No address book, but you can search Switchboard.com for e-mail addresses.	★★ The bare-bones minimum: no address book, and you have to extract attachments, save them to disk, and decode them. You can't save a draft.	★★★★ Well-designed editor, with a spell-checker, a thesaurus, and an option to save a draft without sending. It supports blind copies. All sent messages have an ad for Hotmail at the end.	★ Simple and straightforward, with an address-book feature and file attachments, but this is the only service that doesn't display the text of HTML-formatted mail.
Message management	★★ Basic message storage with none of the folders and search features available in AOL's own software.	★ No folders, but an option to forward your e-mail to another address	★★★★★ Multiple folders supported, with filtering options for automatic filing and a search feature.	★★ In the version we tested, you can create multiple folders, but you can't filter mail automatically. E-mail delivery was very slow, and iName's server refused some messages.
Security	★★★★★ Messages aren't stored in your browser's cache. You need an AOL screen name and password to sign on.	★ Messages remain in the browser cache after you leave the Web site and can be read by anyone who uses the computer after you do.	★ Messages remain in the browser cache after you leave the Web site and can be read by anyone who uses the computer after you do.	★ Messages remain in the browser cache after you leave the Web site and can be read by anyone who uses the computer after you do. During our testing, iName was mail-bombed, and the server returned all messages that had been sent to it over the past two days
Advertising/spam	★★★★ Although we did not encounter unwanted mail in testing, be aware that AOL has a reputation as a spam factory	★★★★ When we tested, the interface was in flux, and no ads appeared at all.	★★ Annoying animated ads appear at the foot of the window. You can block e-mail from users whose names you specify.	★★ Annoying animated ads appear at the top of screens.
Advanced features	— None.	— None.	★★★★★ You can access up to four POP mailboxes, specify whether messages are quoted in replies, and set almost as many filing and filtering options as you can in a standalone e-mail client.	★★ Incoming e-mail can be forwarded automatically. You can choose from other domain names, and 300 additional domains are available for $14.95 a year. You can access iName mail messages with an ordinary mail client for $23.95 a year.

ily Edition, a free program that includes some attractive options. Family Edition has two different interfaces: Pro, an interface designed for older children and adults that closely resembles the interface of ProntoMail Professional Edition; and Fun, an interface for younger children. Fun is highly graphical. Its mailroom has a gamelike interface, and a talking animated bear helps kids create and send mail. Family Edition also includes an integrated browser.

Finally, Family Edition lets you share one account among family members by appending a name to the end of the address—for example, *Smithfamily @myisp.com(Tommy)*. Internally, Family Edition routes mail to separate in-boxes as it retrieves the mail, as though each member of the family is using a separate account. The program can automatically place a copy of all mail sent to children into a main mailbox for parental monitoring.

For home users, the Family Edition is a good option. But ProntoMail Professional Edition needs support for multiple accounts and HTML mail to compete in this catagory.—*GA*

ProntoMail Professional Edition. Price: free download. CommTouch Software Inc., Sunnyvale CA; 800-638-6824, 408-245-8682; www.commtouch.com. *Choose 523 at www.pcmag.com/infolink.*

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None	www.eudora.com, www.excite.com, www.ivillage.com, www.mailcity.com	None	None	www.rocketmail.com
★★★★ The setup is reasonably easy and automated, but for our ISDN modem we had to set up manually.	★★★★ The questionnaire is moderately straightforward. No phone number is requested.	★★★★ Up to six people can be notified automatically of your new address. The marketing questionnaire is brief, but you have to give an address.	★★★★ The questionnaire is simple and brief. You aren't asked for a phone number or a mailing address.	★★★★★ The questionnaire is very simple, with a marketing survey you can ignore
★★★ Simple and clear	★★★ Clear and simple design. The message list doesn't indicate which messages have attachments.	★★★★ Uncluttered design, with informative message lists that indicate whether a message has been read and whether it has attachments.	★★★ Simple but crowded, with many fill-in fields jammed into narrow frames. Expect slow loading and some JavaScript errors	★★★★★ Elegant, uncluttered, informative, and ad-free.
★★★ Basic features, plus spell-checking and an address book. You can't attach files to outgoing messages. You need to find your own separate decoding utility to deal with incoming attachments. A three-line ad appears at the end of every sent message.	★★★★ In-line graphics are displayed in the reader, although HTML formatting is ignored. You can save drafts and attach files when composing outgoing mail. All sent messages have an ad for MailCity at the end.	★★★★ The service supports HTML-formatted e-mail. An option lets you display in-line graphics or show them as icons that you have to click to view. All sent messages have an ad for Net@ddress at the end.	★★★ Simple and adequate, with no formatting, but spell-checking, file attachment, and address-book management are easy to use. You can't save a draft unless you send immediately. All sent messages have an ad for ProntoMail at the end.	★★★★ The service supports HTML-formatted e-mail and displays in-line graphics. The address book is easy to manage. You can save drafts before sending. All sent messages have an ad for Yahoo! Mail at the end.
★★★ You can create folders, but you can't filter mail.	★★★ You can create folders, but you can't filter mail.	★★★★★ Multiple folders, and the service handles automatic message filtering effectively.	★★★ You can create folders and move messages among them. The folder lists have icons to show you which messages you've read and which have attachments	★★★★★ Multiple folders, automatic filing rules, and a search option combine to give you almost all the features of an e-mail client
★★★★ Access to the program is password-protected.	★ Messages remain in the browser cache after you leave the Web site and can be read by anyone who uses the computer after you do.	★★★★★ A log-on option expires pages, so they will not be stored in the cache	★ Messages remain in the browser cache after you leave the Web site and can be read by anyone who uses the computer after you do.	★ Messages remain in the browser cache after you leave the Web site and can be read by anyone who uses the computer after you do.
— Juno was the only e-mail service that sent us messages with ads, and ads appear when you start the program itself.	★★★★ Annoying animated ads appear at the top of every screen. You can block e-mail from known spammers, from a specific list, or from anyone not in your address book or to whom you didn't write a message.	★★ Annoying animated ads appear at the top of pages. You can block e-mail from known spammers and from specific addresses.	★★ Moderately unobtrusive ads appear in frames below your messages. You can block incoming e-mail from individual addresses or known spammers or accept mail only from names in your address book.	★★★★★ The interface is ad-free, and you can block messages from known spammers
★ Built-in spell-checking and nothing else.	★★★★★ You can access multiple POP accounts and set up automated vacation replies.	★★★★★ You can schedule messages to yourself or others. You can access up to seven POP mailboxes.	★ Each user gets a customizable one-page home page in any of four preset formats.	★★★★ You can access up to three POP accounts, set options for quoting replies, and schedule messages to yourself or others. The Yahoo! ticker can be used for e-mail notification

CE Software Inc.

QuickMail Pro

There's little chance you'll mistake CE Software's QuickMail Pro 1.5.2 ($60 street) for any other e-mail client. QuickMail has an unusual interface and unique features, such as graphical message templates. Yet it is missing some of the basics, leaving us with the impression that QuickMail is more style than substance.

A descendant of a long line of Macintosh products, QuickMail for Windows closely resembles its Mac counterpart. Its message window consists of a single pane that lists all the folders. You can create your own folders, but you can't nest them within other folders. When you double-click on a folder, the messages within it appear below. On our tests, this approach often resulted in a cluttered screen. One useful feature, similar to AutoPreview in Microsoft Outlook 98, allows you to preview the first several lines of a message. A MailTicker applet displays new messages and their subjects as they arrive, even if you do not have the mail program open.

QuickMail adroitly handles multiple users: Users can sign off and on without exiting the program. But its support for multiple accounts is not so seamless. To

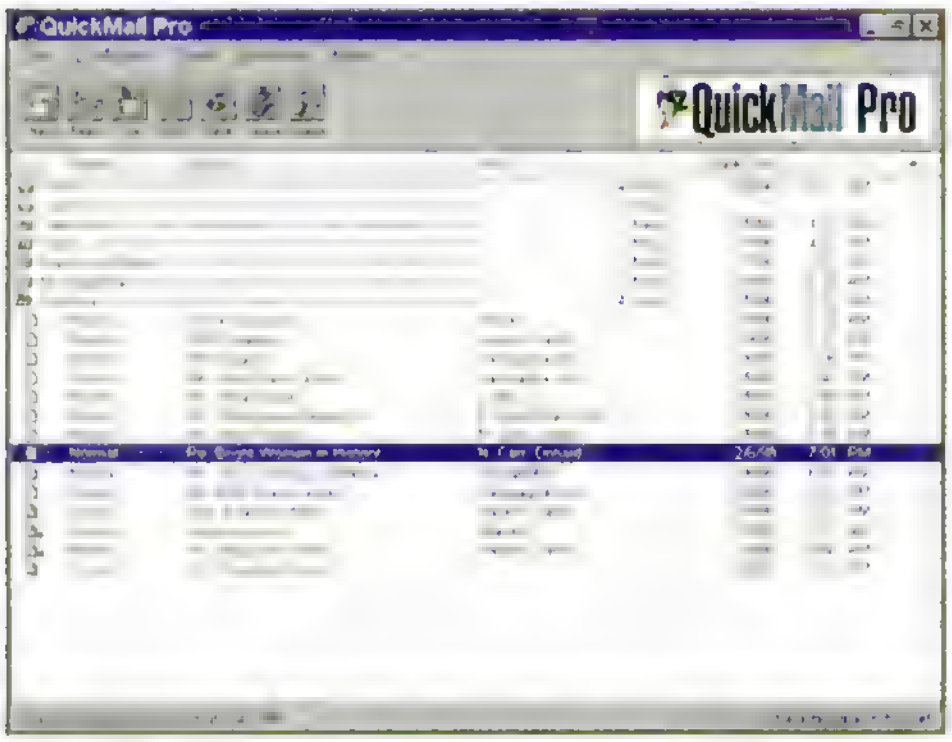
access multiple accounts, you must create a separate user account for each and log off one user's account before signing on to another. You can't check more than one account at a time, as you can in Outlook 98 and Outlook Express.

QuickMail comes with more than 20 graphics-intensive templates, ranging from business forms to personal messages. Only other QuickMail users can view the graphical templates. And if you want to use a template, you must select it before creating a message: You can not add it after you've started to type your message.

Since QuickMail has only a single-pane interface, managing messages can be quite clumsy. If your folders contain many messages, dragging and dropping between them can be arduous. The icon showing that a message has an attachment is barely discernible, and the message itself provides no indication that it has an attachment. (You must use a menu item to open a separate attachments-dialog box.) QuickMail's rules-based message filters examine message content and can automatically delete, move, forward, or reply to messages.

The program supports LDAP, and when you search a public directory such as Four11, you can add an address to a message with a single mouse click. Adding the same address to your address book is a more complicated process.

QuickMail is a product in limbo. It is too clumsy for beginners, and it is missing too many features to satisfy more experienced users. With current versions for both Windows and Macintosh, QuickMail may appeal to some organizations with mixed environments. We recommend that others look elsewhere.—*DH*



QuickMail Pro's interface resembles that of the Macintosh version, which will frustrate Windows users.

QuickMail Pro 1.5.2. Street price: $60. CE Software Inc., West Des Moines, IA; 800-523-7638, 515-221-1801; www.cesoft.com. *Choose 524 at www.pcmag.com/infolink*

TeamWare Group

TeamWare Embla

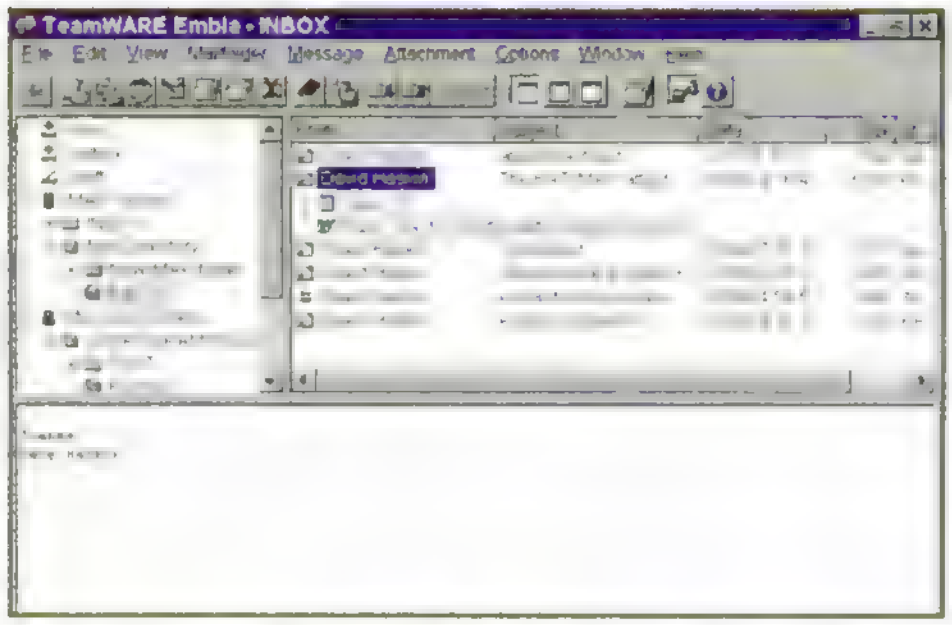
One of the first products to embrace IMAP, TeamWare Embla 2.1 ($49 list) is a smoothly functioning POP3 and IMAP4 client that also offers a host of intriguing workgroup features. But for every bright spot, TeamWare Embla also has a dark cloud, and its interface feels like a work in progress.

When you first launch TeamWare Embla after installing it, the program is on its best behavior. It displays a start-up wizard that guides you through the initial setup process. And initially, we were impressed with its clean, three-pane interface, which is similar to that of Internet Explorer. But the more we used the program, the more frustrated we became.

For instance, the procedure to create and manage multiple accounts isn't immediately clear: You must select a menu option for modifying folders and address books. You can create your own system of folders, but nesting folders within other folders is, again, unnecessarily confusing. That's because you can create both *folders,* which can have subfolders, and *mail folders,* which can't.

TeamWare Embla's message composition features are also a mixed bag. You can create messages with basic formatting but not in HTML. One clever feature allows you to attach the entire contents of a Windows folder, including subfolders, to an e-mail message. This feature is especially useful when, for example, you want to send all files pertaining to a specific project to other team members. But it only works when recipients also use TeamWare Embla.

The program is most notable for its thorough IMAP4 support. On our tests, we sent and received mail through an IMAP server, created folders on the server, moved messages between server-based folders, and downloaded selected messages, all without a hitch.



TeamWare Embla has strong IMAP4 support, but its interface could use an update.

You can configure TeamWare Embla to filter messages based on content, size, and date. But the actions that can be triggered by a filter are limited to deleting, copying, and moving messages. In addition, TeamWare Embla can perform simple text searches but not Boolean searches.

Embla includes a multilingual spell-checker, and the software supports both 7- and 8-bit character sets, making it a good choice for international organizations. Finally, TeamWare Embla's off-line features deserve mention. By clicking on a toolbar button, you can download messages and disconnect from the server, read and organize messages, and queue up responses and new messages to be transmitted when you log on again.

At times, TeamWare Embla seems to be the product of some inspired thinking. But ultimately, it fails to deliver the features or the usability you'd expect in a sophisticated e-mail client.—*DH*

TeamWare Embla 2.1. List price: $49 (download, $39). TeamWare Group, San Jose, CA; 888-248-9273, 408-432-1300; www.embla.com. *Choose 525 at www.pcmag.com/infolink.* PC

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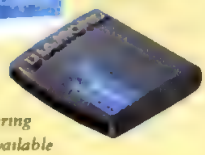

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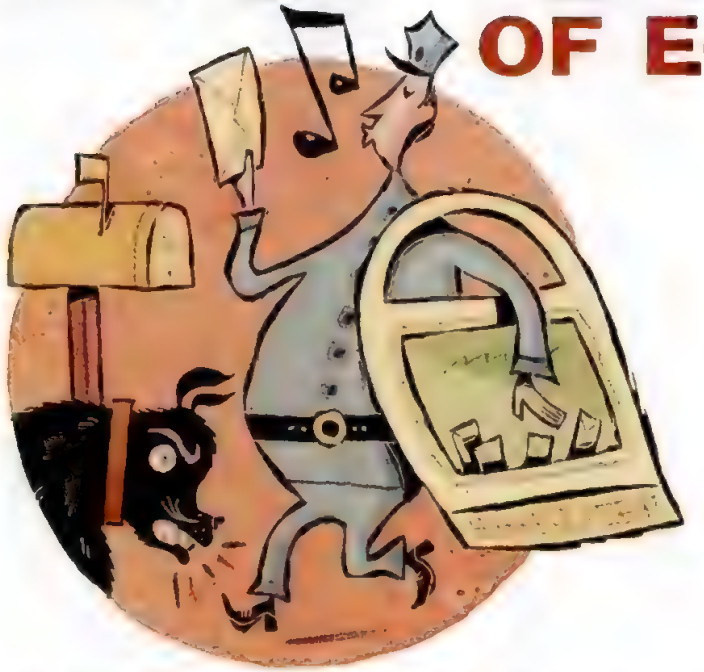
THE Server Side OF E-MAIL



IMAP is finally leveling the playing field for e-mail servers and groupware packages. Read on to see which is right for your business.

By Les Freed

Conventional wisdom holds that, though e-mail is fine for small companies, large organizations need groupware. But that's not always the case. Whether your company needs a single Internet mail server or the functionality of calendaring, document sharing, and discussion that groupware delivers on top of rich messaging depends on how your business works. You'll need to assess that on your own, but our coverage here will help you sort out the benefits and drawbacks of both e-mail and groupware.

In our main roundup, we review a field of 11 mail servers that support the Internet Message Access Protocol, Version 4 (IMAP4), a protocol that has helped to bring standards-based Internet mail products closer in line with proprietary mail systems such as cc:Mail and MS Mail, as well as the mail features in groupware products such as Lotus Notes, Microsoft Exchange Server, and Novell GroupWise. We also review five groupware packages, including all of their bundled applications beyond messaging.

We compared the groupware systems but also tested their standalone mail servers against the IMAP e-mail servers. Three of the groupware mail servers can be pur-

IN THIS REVIEW

Mail Servers
Eudora WorldMail Server 2.0 161
IMail Server 4.0 for Windows NT 162
Infinite InterChange 3.10 162
MailSite SQL Enterprise 2.1.5 163
Mercur 3.0 164
Netscape Messaging Server for NetWare ... 164
N-Plex Office 1.31 168
NTMail 3.03C 168
OpenMail 5.10 169
Simeon Message Service 2.0.1 169
Sun Internet Mail Server 3.2 170
Groupware
Lotus Domino, Designer, Desktop 4.6a 171
Microsoft Exchange Server 5.5 172
Netscape SuiteSpot 3.5 178
Novell GroupWise 5.2 180
TeamWare Office 5.1 182

ILLUSTRATION BY ADAM McCAULEY

Choosing the Right Messaging Product

Do you want features such as threaded discussion, calendaring, document management, and development tools?

YES → **Consider a groupware product.**

NO → **Consider a mail server.**

Supporting a groupware system is no small undertaking. Are you prepared to support a full-time IS professional and a dedicated server?

NO → Then **consider a teamware product.** Teamware provides collaborative features accessible via a browser.

YES → **Which platform do you use?**

All these groupware products run on **Windows NT.** If you use **NetWare,** consider all the products except Microsoft Exchange, which runs on Windows NT only. For **other OSs or cross-platform solutions,** consider Lotus Domino or Netscape SuiteSpot.

Do you need strong database and applications development capabilities?

Then consider **Lotus Domino.** It includes the most comprehensive toolset and a large base of developers and preexisting applications.

Do you want to build a messaging system around open standards?

Then consider **Netscape SuiteSpot.** Its applications are centered on LDAP and include the ability to plug in other vendors' products.

What platform are you running?

Unix → **Unix** shops can choose OpenMail, Simeon Message Service, or Sun Internet Mail Server.

NetWare or Windows NT → **NetWare** shops can use Netscape Messaging Server, while **Windows NT** organizations can select among the remaining servers.

How many users do you have?

If you have a large number of users, you should consider the Unix products: OpenMail, Simeon Message Service, and Sun Internet Mail Server.

Novell, N-Plex Office, and NTMail position themselves as **midrange:** able to scale to more than 500 users. The remaining products are strictly for **smaller businesses.**

Do you need remote Web administration?

N-Plex Office offers the best remote-administration capability. Avoid OpenMail and Simeon Message Service, which allow only telnet management. Infinite InterChange and Microsoft Exchange offer no remote management at all.

Is security an important consideration?

Netscape Messaging Server is the only product here with automatic SSL encryption. Mercur lets you encrypt all incoming and outgoing messages. Sun Internet Mail Server offers optional encrypted messaging and administration on Unix and Win32 platforms. Simeon Message Service is compatible with Kerberos encryption.

chased separately—those from Lotus, Microsoft, and Netscape. We evaluated the products that run on multiple platforms on Windows NT; we tested GroupWise and Netscape Messaging Server on NetWare; and we examined the three Unix-only products on Solaris.

Internet standards such as IMAP and LDAP have become more important. An IMAP server stores all your messages on the server, the same way a groupware system does. This lets you manipulate your message store as you would any other data, organize messages into nested folders, and create shared folders. LDAP is a standards-based directory service that provides a means for OSs and applications to share user information—a luxury formerly afforded only to proprietary systems.

MAIL SERVER OR GROUPWARE?

If the messaging capabilities of mail servers are now more akin to proprietary mail systems, how do you choose which is best for your company?

Although messaging is similar in both,

Editors' Choice

- Groupware: Lotus Domino 4.6a with Lotus Notes
- IMAP4 mail servers: Microsoft Exchange Server 5.5

PC MAGAZINE EDITORS' CHOICE

This year's messaging roundup yielded some mild surprises. The best IMAP server is Microsoft Exchange Server, a groupware product, and despite some strong challenges, the best groupware system continues to be Lotus Notes.

Though more of an evolutionary advance than a revolutionary one, Version 4.6a of Lotus Domino 4.6a (single-processor version, $1,495 list for single processor version) and the Lotus Notes Desktop client ($65 list) each brings notable improvements to an already full-featured package.

The Notes client interface receives a face-lift with Personal Portfolios, a database of databases that makes organizing and navigating information easier. And improving on its industry-leading development tools, the vendor has introduced Lotus Notes Designer ($495 list), a full version of the Notes client that also includes a separate development environment.

But the key improvements in this version all stem from Internet integration. Lotus Notes can now store and manipulate Web pages as it can any other Notes document, and a new Web Administrator lets you perform secure remote management from any browser.

All in all, we found the first batch of IMAP4 servers full of promise. Many excelled in one or two areas, but none demonstrated the ease of use, power, and security of some IMAP servers that are part of groupware systems. Microsoft Exchange Server 5.5 ($999 list for 5 users) was just ahead of Lotus Domino—and the most impressive.

The easiest server to set up and administer, Exchange includes a rich feature set that includes an LDAP directory, development tools, and a superb Web mail client interface. Its only drawbacks are a lack of Web-based administration and the requirement that you'll have to pay extra for the Outlook client.

groupware products go beyond e-mail in two key areas: feature set and support requirements. Groupware provides collaborative tools such as threaded-discussion forums, a calendaring or scheduling application, and a file-distribution system. Some packages also provide development tools and migration features.

Such features and flexibility may come at a substantial cost, though. Rolling out a groupware package in a large company is expensive and requires more administrative and technical support than a comparable e-mail system. If you opt for groupware, you may find you need to dedicate a server to run the application and assign a qualified, full-time support person to maintain it. Many small companies will find they simply don't have the resources to support a groupware package.

And though groupware is great for information-based organizations, it's simply overkill for many companies—large or small. If your users don't need the additional features provided in a groupware package, then there's no reason to spend the time, money, and effort required to provide them.

But what about the small group that wants collaboration tools but isn't prepared to support groupware? Such groups would do well to consider a teamware product such as HotOffice, which offers messaging and collaborative tools that your group can access from a browser. (For a roundup of these products, see our February 10 story "Instant Groupware.")

www.pcmag.com
Still need help deciding? Join us online, where you can go through an interactive version of Choosing the Right Messaging Product

SETTING UP SHOP

The IMAP messaging servers we tested cover a lot of ground. They range from simple, inexpensive products such as Ipswitch's IMail Server for Windows NT that provide e-mail to small groups, to Unix-based behemoths such as HP's OpenMail, geared to connecting thousands of users.

These products are generally easy to install and maintain. Most include a utility to import user-directory information from the operating system—an important feature if you have hundreds of users. Upon installing Netscape Messaging Server for NetWare, for example, the server automatically creates an Internet mailbox for every user in your NetWare directory.

We expected the groupware servers to be much more difficult to install and maintain than the IMAP servers. Some of the groupware products—notably Novell GroupWise—were indeed difficult. But two products—Microsoft Exchange Server and Fujitsu's TeamWare

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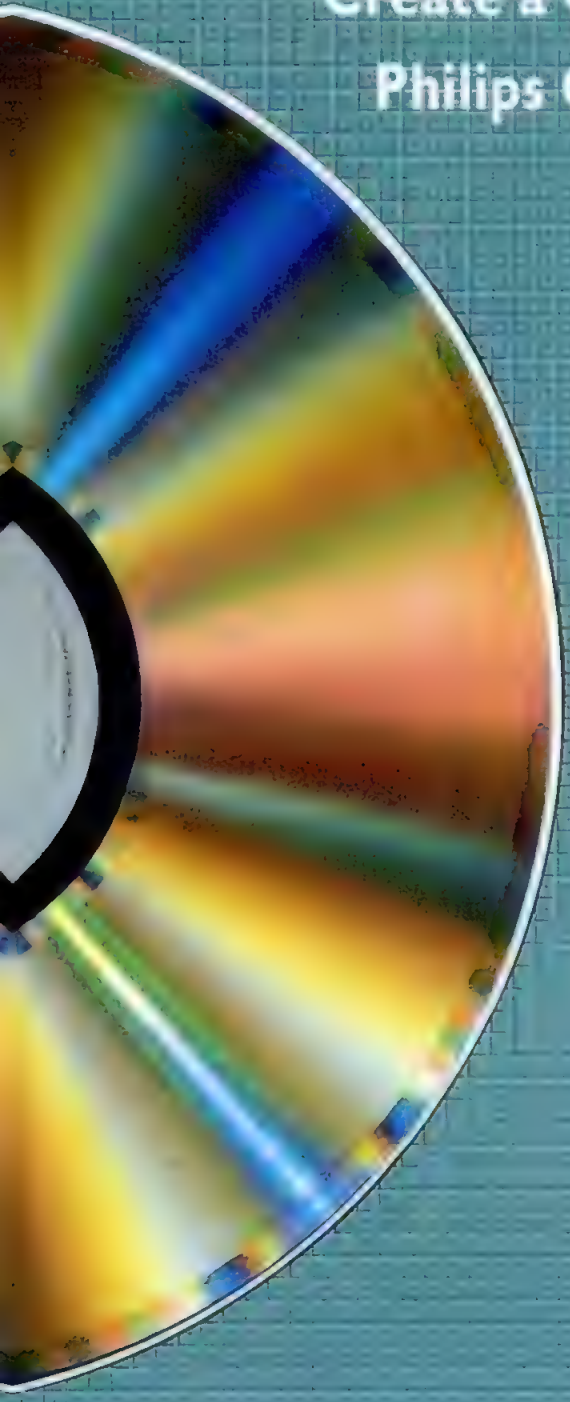
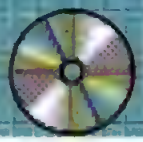
Create a CD on your PC with the Philips CD-ReWritable Drive.





Onita Mihaly

My Web Site

Annual Budget

Vacation Video

Work Stuff

My New Song

PC MAGAZINE EDITOR'S CHOICE

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Office—were exceptionally easy to install and configure.

We encountered no compatibility problems with any of the IMAP servers we tested. They all worked correctly with Eudora Pro, Microsoft Outlook 98, and Netscape Messenger and Collabra (in beta), indicating good adherence to the IMAP protocol standard. We did not test the performance of these products.

ON YOUR WAY

If you're still not sure whether to buy groupware or an IMAP server, you may be able to postpone your decision. Exchange Server, for example, includes data and user migration tools that let it take over your existing e-mail message store and user database, as well as the ability to convert databases from other groupware packages such as GroupWise.

But no matter what package you implement, it's sure to have an impact on your existing infrastructure. Since mail servers store all your messages until you delete them, this greatly increases storage requirements. Many products address this issue by letting the administrator restrict users' mailbox sizes—either by number of messages, by the size of each message, or by total size.

To combat a swelling message store, some products—NTMail for instance—offer filtering tools for deleting unwanted mail upon receipt.

HOW WE TESTED

We used the same test-beds for evaluating groupware and IMAP mail servers. Our server for Windows NT and Novell was a Dell PowerEdge 2200 with a 233-MHz Pentium II processor, 128MB of RAM, and a 4GB hard disk. We used Windows NT 4.0 with SP3 and Novell's NetWare for Small Business 4.11. To test the Unix products, we used a Sun Netra with a 150-MHz UltraSparc chip, 220MB of RAM, and a 2GB hard disk running Solaris 2.6. We attached two HP Vectra clients to each server over 10Base-T. The Vectras had 32MB of RAM, 1.6GB hard disks, and 155-MHz MMX processors.

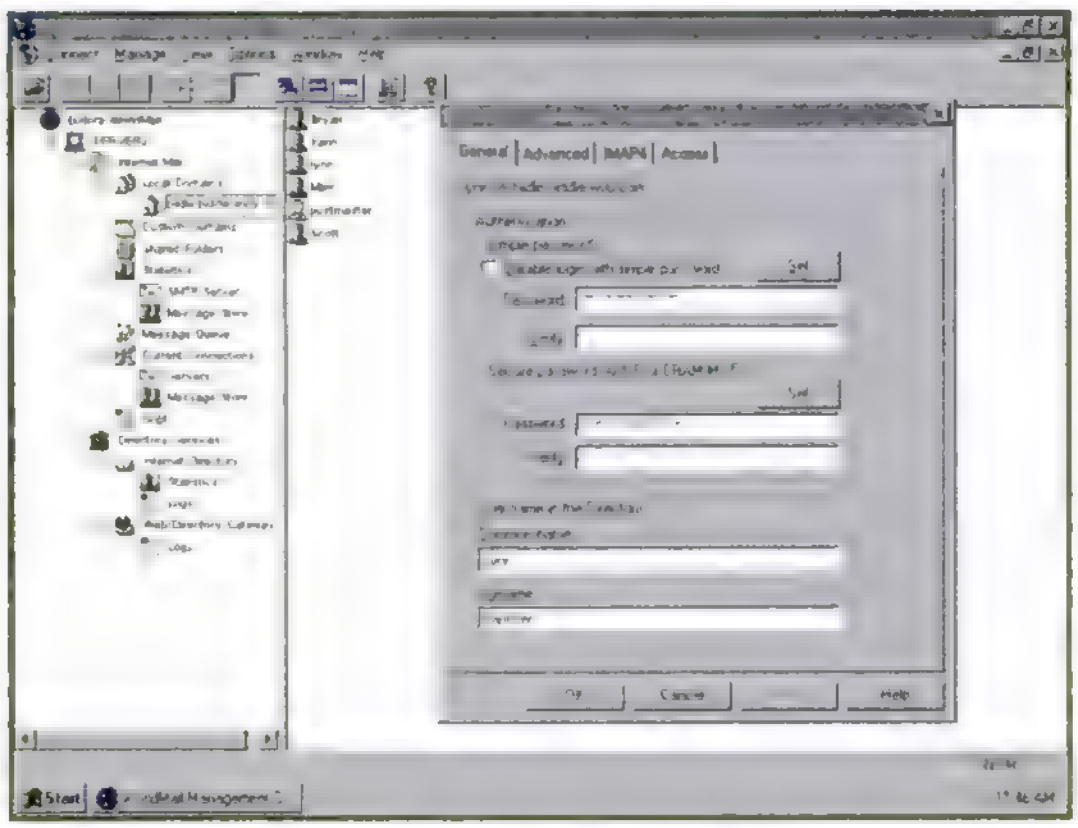
Mail SERVERS

Qualcomm Inc.

Eudora WorldMail Server

If you are looking for a cheap and easy way for your small business to send Internet mail, Eudora WorldMail Server 2.0 is an excellent choice. The lowest-priced server in this roundup ($159 list for ten users), Eudora WorldMail Server offers most of the functionality of more expensive packages, including remote administration, LDAP support, and list servers. But although Eudora can scale up for midsize organizations, the product lacks some security features and administrative capabilities that most larger groups would find imperative.

You can purchase Eudora from Qualcomm's Web site or, for the same price, buy it in a retail store and get an excellent printed manual with a good index and e-mail primer. The price includes Eudora Lite client software.



Eudora's Explorer-style display and friendly icons make administration easy.

It's not surprising that Qualcomm, long a player in the messaging market, has produced a polished, accessible product that even a network administrator with no prior mail management experience will find easy to set up and maintain. Well-conceived installation wizards walk you through each step of the setup process.

We found Eudora's administration tools relatively easy to use. The administrative interface is Windows Explorer–like; you click on the icons to drill down into greater levels of detail. Granting users selective access to shared folders is easy: simply select the list of available folders when setting up each user, then select each folder you want the user to access. If you want to enable encrypted passwords or restrict a user to logging in at specific times, all you have to do is click on the appropriate check boxes. You can limit the mail store by size but not by number of messages. Eudora allows users access to their mail from any Java-enabled browser.

One notable limitation to Eudora is its inability to import user data from the Windows NT User Directory, which means you'll need to input user data manually. For small groups, however, this shouldn't take much additional time, although administrators whose groups use the Eudora client will benefit from an auto-configuration option that imports the Windows NT user data.

If you do not require sophisticated security measures such as SSL and digital signatures, Eudora's password encryption offers an acceptable level of access security. As with many of the packages we examined, security is a combination of that offered by Windows NT and by the application itself.

We liked the Group Managers feature, which lets you specify to whom you grant administrative rights over specific groups or domains. On a corporate intranet, this allows highly divisionalized companies to maintain closer control over departmental domains.—*Ted Needleman*

Eudora WorldMail Server 2.0. List price: Up to 10 users, $159; additional 10 mailboxes, $99. Requires: Pentium-based PC, 32MB RAM (64MB recommended), 1GB hard disk space, Microsoft Windows NT 4.0 or later. Qualcomm Inc., San Diego; 800-238-3672; www.eudora.com. *Choose 500 at www.pcmag.com/infolink.*

SUITABILITY TO TASK: MAIL SERVERS

	Eudora WorldMail Server 2.0	IMail Server 4.0 for Windows NT	Infinite InterChange 3.10	MailSite SQL Enterprise 2.1.5	Mercur 3.0	Netscape Messaging Server for NetWare	N-Plex Office 1.3	NTMail 3.03C
Administration	Good	Excellent	Fair	Good	Good	Good	Good	Fair
Messaging	Good	Good	Fair	Good	Good	Good	Good	Fair
Web access	Good	Good	Good	Good	Good	Fair	Fair	Good
Ease of use	Excellent	Excellent	Fair	Good	Good	Excellent	Fair	Good

N/A—Not applicable: This product does not offer Web-based mail access.

Here we evaluate both the mail servers and groupware products in terms of how well each product implements IMAP features. Interestingly, we found some of the best mail servers among the groupware packages. We do not evaluate any of the groupware systems' collaboration features in this chart. For a full evaluation of the groupware packages, see the groupware Suitability to Task chart later in this story.

Administration We evaluate the server installation and setup. In particular, we examine creating a user directory, and we prefer a product that includes an LDAP directory. In general, we look for integration with the network operating system, and we rate how easily you can add new users and create groups. Remote administrative tools that provide complete access are important. We evaluate logs and troubleshooting tools.

Messaging We prefer products that let you control the size of the message store, either by total volume or by number of messages. We look for settings to limit the size of each client's

Ipswitch Inc.

IMail Server for Windows NT

Ipswitch's IMail Server 4.0 for Windows NT ($495 list for unlimited users) handles all Internet mail chores ably. IMail features good print and online documentation as well as a useful information manager and list server. The package would be better if remote management and the Web access interface were improved and if additional security features were added. Even so, IMail's many pluses make it a fine fit for both small and midsize businesses.

A clean administrative interface makes managing users easy. Tab sheets make viewing and modifying configuration parameters straightforward, and you can import users from your Windows NT User Directory. If you want to separate your organization by group, IMail lets you set up multiple local mail domains, each with its own IP address. You can also assign administrators to each domain, a feature usually found only in groupware packages.

IMail provides flexible control over user accounts and lets you set limits for the message store by both file size and number of messages. You can also set up aliases for each user, and you can even set up an address alias that routes messages to multiple persons. IMail includes an LDAP interface that lets users manage their own attributes (phone numbers, departments, and so on) and access other users' information. IMail's adequate remote administration is accomplished with either Windows NT's iradmin program or by means of the Web Messaging program.

To access mail via a browser, you need to add Ipswitch's Web Messaging server ($195 list). We found the interface unintuitive; it lets you view top-level folders only, not nested folders. Web Messaging provides remote administration by letting you add, modify, and delete users, aliases, and lists. Neither the iradmin nor the Web Messaging administration sessions are encrypted, though, and the server doesn't support SSL.

IMail also features a better-than-average list server that lets users self-subscribe and get assistance through standard list server commands, such as subscribe, list, and help. In addition, you can set up private and moderated mailing lists.

Finally, IMail includes two unique utilities: The Mail-to-Pager program lets you send an alert to a recipient's beeper or an alphanumeric message to a pager. The Mail-to-Fax utility creates and sends a fax message. In addition to these, we also liked the information management feature, which lets you configure automatic replies to senders, useful for technical support groups.—*Robert P. Lipshutz*

IMail Server 4.0 for Windows NT. List price: Unlimited users, $495; Web Messaging, $195. Requires: 486-based PC or better, 16MB RAM, 20MB hard disk space, Microsoft Windows NT 3.51 or later; for Pentium-based PC, 32MB RAM recommended. Ipswitch Inc., Lexington, MA; 781-676-5700; www.ipswitch.com. *Choose 502 at www.pcmag.com/infolink.*

Infinite Technologies

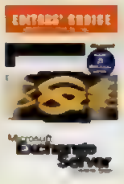
Infinite InterChange

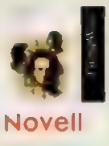
As its name suggests, Infinite InterChange 3.10 ($349 list for ten users) is an Internet mail gateway that provides IMAP4, POP3, and Web-based mail clients access to a standard Internet SMTP mail server (included in the product), as well as a host of other mail systems, including Lotus cc:Mail, Microsoft Mail, and Exchange.

The server lacks useful features we've seen in other products, such as LDAP support, remote management, a list server, and security features such as SSL. The product's outstanding Web access makes up for this somewhat and helps position InterChange as a good solution for organizations with many remote users.

The server is fairly easy to set up, but it has no way to import user data automatically from the Windows NT User Directory. You can configure users to access the server from a predefined IP address range only, which is useful for security. There is no ability to set mail store size limits for users. Moreover, configuring aliases is cumbersome, since you must do this in a separate screen from that containing the user information. Even worse,

GROUPWARE





OpenMail 5.10	Simeon Message Service 2.0.1	Sun Internet Mail Server 3.2	Lotus Domino 4.6a	Microsoft Exchange Server 5.5	Netscape SuiteSpot 3.5	Novell GroupWise 5.2	TeamWare Office 5.1
Good	Good	Good	Good	Excellent	Excellent	Fair	Good
Good	Good	Good	Excellent	Good	Good	Good	Good
Good	N/A	N/A	Excellent	Excellent	Good	Good	Good
Poor	Fair	Fair	Fair	Excellent	Good	Poor	Excellent

mailbox. A superior package automatically warns a user when the mailbox is approaching its limit. We also check for administrative control over error conditions and retries.

Web access The servers with maximum flexibility go beyond the IMAP specification to let users access their mail via a Web client. The best packages let you view nested folders and respond to mail with attachments. The ability to access personal address books and spell-checkers via the Web is a plus.

Ease of use Here we evaluate the ease of the server installation process and the available documentation. Although we expect a computer-savvy user to set up and configure the server, the best products require little additional technical support. The controls and settings should be easy to navigate, and user profiles should be easy to edit, making it feasible for a less experienced user to maintain the server. When comparing ease of use, we consider how the complexities of certain NOSs affect tasks.

the system failed to catch our mistakes when we added aliases that translated to undefined user names.

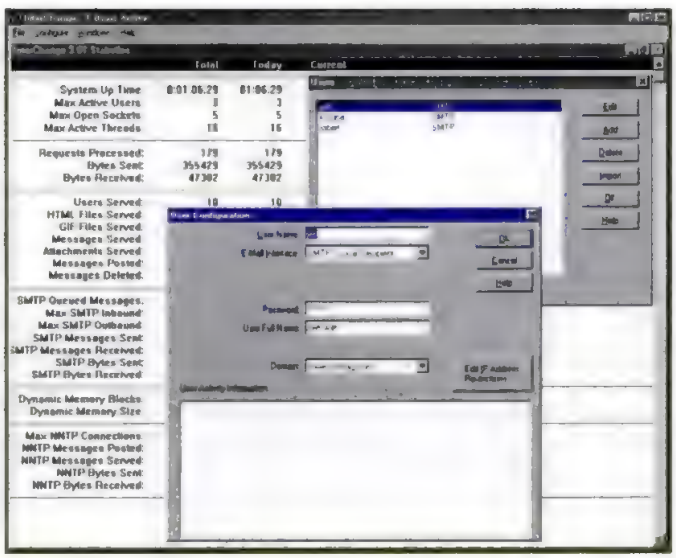
On the other hand, we liked InterChange's server-based rules. These permit administrators to set up rules for users based on the information contained in an incoming message. You can configure messages to be stored in a separate folder, marked as urgent, or even deleted upon receipt. We would have liked the user to have some control over the rules, though.

For monitoring, administrators can choose to view an activities log, an active user display, statistics including the number of messages and attachments posted, and a list of accounts that have been locked out. Unfortunately, you cannot view any of these screens simultaneously.

InterChange includes a number of unique capabilities useful for small offices with slow network connections. The server can act as a remote domain with intermittent connectivity to a central mail server, such as an ISP; you can also set up UUCP (Unix copy) to access a mailbox on a remote machine, which is useful for branch offices.

The WebMail interface was the best Web client in this roundup. The feature comes complete with a spell-checker, a search utility, and a useful address book with distribution lists. You can even view a list of all the users' e-mail addresses.—*RPL*

Infinite InterChange 3.10. List price: 10 users, $349; 25 users, $599; 50 users, $999; 100 users, $1,499; 250 users, $2,499. Requires: 486-based PC or better, 2MB RAM, Microsoft Windows 95 or Windows NT 3.51 or later. Infinite Technologies, Owings Mills, MD; 800-678-1097; www.infinitemail.com. *Choose 502 at www.pcmag.com/infolink.*



InterChange's administration interface is simple to use but a bit cluttered.

Rockliffe Systems Inc.

MailSite SQL Enterprise

If you run SQL applications on either Windows NT or Windows 95, MailSite SQL Enterprise 2.1.5 is worthy of consideration. The product accesses SQL databases (not included), either for the purpose of adding users or for merging SQL database information with MailSite's list-processing capabilities. The company offers several versions of MailSite, including the Enterprise SQL version we tested ($1,995 list). Although other servers such as Mercur offer ODBC connectivity, MailSite makes a perfect Internet mail adjunct for organizations built on Microsoft BackOffice, for example. One of the few mail servers in this roundup able to access SQL, MailSite is one of the most scalable Windows NT solutions we tested.

MailSite uses a familiar wizards-based setup to guide you through the installation process. The administration of the system is accomplished via the MailSite Console, which displays the available administrative settings in a tabbed box that floats on top of the program's directory structure. The interface is more graphical and intuitive than most,

with icons that make tasks simple.

Under Windows 95, you must create user mailboxes manually, but under Windows NT you can import users from the Windows NT User Directory. In addition to SQL databases, MailSite also supports generic ODBC and Emerald Radius Server systems. To create a mailbox using database information, you must first install the proper database driver, then configure the Database Mailbox Plug-in. We found this process straightforward.

Many of the Windows NT servers we tested are quite similar. And while MailSite's SQL capabilities differentiate it somewhat, its features are comparable to those of the competition, including remote access via a browser and a list server. There is limited security (just password encryption) but no LDAP support. You can control the message store by size and number of messages, as well as by incoming message size.

Documentation is superior to most of the products in this roundup. MailSite offers step-by-step examples when this is most appropriate and helpful, such as when setting up database access for creating user accounts. And although Mercur lets you use ODBC database information to create mail users, MailSite's documentation helped make the process quicker and easier.—*TN*

MailSite SQL Enterprise 2.1.5. List price: SQL connectivity, unlimited mailboxes, $1,995. Requires: 486-based PC processor or better, 16MB RAM for Microsoft Windows 95 or 32MB RAM for Microsoft Windows NT, 15MB hard disk space, Microsoft Windows 95 or NT 3.51 or later. Rockliffe Systems Inc., Santa Clara, CA; 408-554-0766; www.rockliffe.com. *Choose 503 at www.pcmag.com/infolink.*

Atrium Software

Mercur

If your small business is looking for a mail server with ODBC connectivity, Mercur 3.0 ($250 list, fourteen users) will have plenty of appeal. But like many lower-priced products in our roundup, security features are light, and Mercur does not support LDAP.

Of more concern is the technical support from Atrium Software, a German company with a satellite office in Montreal. The company offers standard support through e-mail only, promising a 48-hour turnaround to questions. Premium support allows you to place a toll call and leave voice mail; Atrium will return the call within 24 hours. Although this level of support might be enough for some applications, mission-critical Internet mail probably isn't one of them.

As with many packages we tested, setup was simple, although Mercur lacks wizards. The User Manager provides a two-pane interface similar to that of Windows Explorer. Various system features, such as users, mailing lists, and auto-responders are displayed on the left panel, while entry forms are displayed in the right. You can import users automatically by leaving Windows NT's User Directory as the default. This will add your new users to Windows NT and Mercur simultaneously.

Adding users can also be accomplished manually or by setting up a separate ODBC user database and importing users from it. An added benefit, ODBC compatibility allows you to maintain logs that you can use with other applications. Mercur also includes extensive mailing list and domain management capabilities.

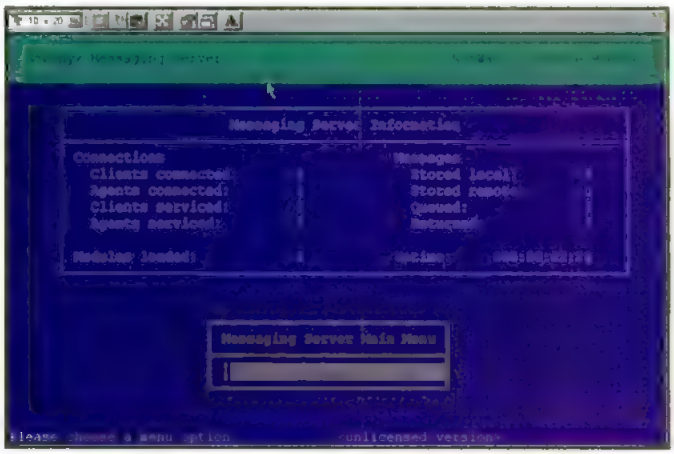
For security, Mercur relies heavily on the Windows NT operating system, though the package has the unique ability to encrypt incoming and outgoing messages so they cannot be read with a text viewer. Mercur doesn't offer robust message filtering like NTMail, though it does provide IP filtering. Mercur also features better-than-average control over the message store, letting you restrict it by size and number of messages and by the size of incoming messages.—*TN*

Mercur 3.0. List price: 5 users, $122; 10 users, $250; 20 users, $330; unlimited users, $640. Requires: 486DX/100 processor or better, 32MB RAM, 10MB hard disk, Windows 95 or Windows NT 4.0 Server or Workstation. Atrium Software, Montreal, Quebec, Canada; 514-990-0556; www.atrium-software.com. *Choose 504 at www.pcmag.com/infolink.*

Novell Inc.

Netscape Messaging Server for NetWare

Although most IMAP mail servers run on Windows NT or Unix, only one is built for the NetWare platform. Netscape Messaging Server for NetWare ($1,425 list for 50 users) goes beyond the basics by providing a fine set of user-administration tools, easy Web access to user mailboxes, and sophisticated security features. If you need a complete set of mail tools for your NetWare LAN and don't need a full-blown groupware package, Messaging Server is a good choice.



Messaging Server integrates with NetWare to provide console displays, such as one that takes the server off-line.

The product is provided on a single CD-ROM and takes less than 10 minutes to install, without taking the network off-line. To install the server, you put the CD-ROM in any NetWare client PC, run the setup program, and answer a few questions. The program installs and configures the server-side programs, and it also adds a Novonyx manager plug-in to the NetWare NWAdmin program. Though Messaging Server adds a status screen to the main NetWare server console, NWAdmin serves as the main administration interface.

Messaging Server creates mail accounts automatically for all your existing NDS users. Although it uses NDS as its primary user database, you can also select a local LDAP directory store as a secondary user database. In addition, Novonyx is developing an NDS-to-LDAP synchronization tool, which should be available by the time you read this. For security-conscious orga-

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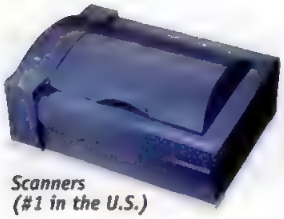
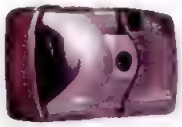


Scanners (#1 in the U.S.)



Digital Cameras

Award-winning Mac-OS Compatibles

Intel-based notebooks and workstations

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SUMMARY OF FEATURES See **www.pcmag.com** for interactive views

Mail Servers

Microsoft Exchange Server 5.5 is the Editors' Choice as a mail server.*

■ YES ▨ NO □ OPTIONAL

	Eudora WorldMail Server 2.0	IMail Server 4.0 for Windows NT	Infinite InterChange 3.10	MailSite SQL Enterprise 2.1.5	Mercur 3.0	Netscape Messaging Server for NetWare	N-Plex Office 1.3	NTMail 3.03C	OpenMail 5.10	Simeon Message Service 2.0.1	Sun Internet Mail Server 3.2
List price	For 10 users, $160	For unlimited users, $495	For 10 users, $349	For unlimited users, $1,995	For 10 users, $250	For 50 users, $1,425	For 20 users, $395	For 51 users and up, $500	For 50 users, $3,000	For 1,000 users, $6,000	For 100 users, $1,495
Supports Windows NT/Solaris	■ ▨	■ ▨	■ ▨	■ ▨	■ ▨	▨ ▨	■ ▨	■ ▨	▨ ■	▨ ■	▨ ■
Other supported platforms	None	None	Windows 95	Windows 95	Windows 95	NetWare 4.1*x*	None	Windows 95	AIX, HP-UX	AIX, Digital Unix, HP/UX, Linux, SGI-Irix	None
IMAP4 clients bundled:											
Windows 3.*x*/95/NT	■ ■ ■	▨ ▨ ▨	▨ ▨ ▨	▨ ▨ ▨	▨ ▨ ▨	▨ ■ ■	▨ ▨ ▨	▨ ▨ ▨	▨ ▨ ▨	■ ■ ■	▨ ▨ ▨
Macintosh/Unix	▨ ▨	▨ ▨	▨ ▨	▨ ▨	▨ ▨	▨ ▨	▨ ▨	▨ ▨	▨ ▨	■ ■	▨ ■ (via the Web)
Install remotely	▨	▨	■	▨	■	■	■	■	■	■	▨
Import user lists from OS	■	■	▨	■	■	■	■	■	▨	■	■
IMAP4 Features Supported											
Off-line/online/disconnected	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Multiple/hierarchical folders	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Shared address book/folders	■ ■	▨ ■	■ ▨	▨ ■	▨ ▨	▨ ▨	■ ■	▨ ■	■ ■	■ ■	▨ ■
IMAP4 and POP3 on the same server	■	■	■	■	■	■	■	■	■	■	■
Uses SMTP pipelining	■	■	▨	▨	▨	■	■	■	■	▨	■
Includes LDAP Directory Server	■	■	▨	▨	▨	▨	■	▨	■	□	■
Management											
Administration via:											
GUI/Command line	■ ■	■ ▨	■ ▨	■ ■	■ ■	■ ▨	■ ■	▨ ■	■ ■	■ ■	■ ■
HTML interface	■	■	▨	■	■	■	▨	■	■	▨	■
Can administer:											
Multiple servers centrally	■	■	■	■	▨	■	■	■	■	■	▨
Multiple domains	■	■	▨	■	■	■	■	■	■	■	▨
Access remotely	■	■	▨	■	■	■	■	■	■	■	■
Can monitor performance and status	■	■	■	■	■	■	■	■	■	■	■
Can administer user accounts by user/domain/server	■ ■ ■	■ ▨ ■	■ ▨ ■	■ ▨ ■	■ ▨ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ▨ ■
Administrator can restrict user by:											
Mailbox size	■	■	▨	▨	■	■	■	■	■	■	■
Times to access	■	▨	▨	▨	▨	▨	■	▨	▨	▨	▨
Incoming message size	▨	■	▨	■	■	■	■	■	■	■	■
Number of messages	▨	■	▨	▨	■	▨	▨	■	▨	▨	▨
Users can modify their own account options	■	■	■	■	■	■	■	■	■	■	■
Provides delivery status (ESMTP)	■	■	▨	▨	■	■	■	■	▨	■	■
User address book on server (IMSP)	▨	▨	▨	▨	▨	▨	▨	■	▨	■	▨
Security Authentication											
SSL	▨	▨	▨	▨	▨	■	▨	▨	▨	▨	■
Qualcomm Password Server	■	▨	▨	■	■	▨	■	■	▨	▨	▨
CRAM-MD5/APOP/X 509	■ ■ ▨	▨ ▨ ▨	■ ■ ▨	■ ■ ▨	▨ ▨ ▨	▨ ▨ ■	■ ■ ■	▨ ■ ▨	▨ ▨ ■	■ ▨ ▨	▨ ▨ ▨
Kerberos/Plain Text	▨ ■	▨ ■	▨ ■	▨ ■	▨ ■	▨ ■	▨ ■	▨ ■	▨ ■	■ ■	▨ ▨
Windows NT Domain	▨	■	▨	■	■	▨	▨	■	▨	▨	▨
Protocols Supported on Server											
IMAP4: RFC 1730	■	■	■	■	■	▨	■	■	■	■	■
IMAP4: RFC 2060	■	■	■	■	■	■	■	■	▨	■	■
MIME / POP3	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
SMTP	■	■	■	■	■	■	■	■	■	■	■
Finger	▨	■	■	▨	▨	▨	▨	■	▨	▨	▨
LDAP	■	■	■	▨	▨	▨	■	▨	■	■	■
X.400 / X.500	▨ ▨	▨ ▨	▨ ▨	▨ ▨	▨ ▨	▨ ▨	■ ■	▨ ▨	■ ■	▨ ■	▨ ▨
Gateways included:											
Notes/cc:Mail	▨ ▨	▨ ▨	▨ ■	▨ ▨	▨ ▨	▨ ▨	▨ ▨	▨ ▨	■ ■	▨ ▨	▨ ▨
Exchange/Microsoft Mail	▨ ▨	▨ ▨	■ ■	▨ ▨	▨ ▨	▨ ▨	▨ ▨	■ ▨	■ ■	▨ □	■ ▨

* Microsoft Exchange Server 5.5 is a groupware product. See the groupware Summary of Features table.

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Time in seconds (shorter is better)

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nizations, Messaging Server provides SSL 2.0 and 3.0 encryption. The server can use X.509 client security certificates, but it doesn't provide a certificate manager.

The administrator has good control over the message store and can restrict the total size of the mailbox. Messaging Server includes a simple but effective spam filter that rejects messages from unwanted domains or individuals. To use it, the administrator enters a list of blocked domain names using NWAdmin. Rejected mail can be left on the server, sent back to the sender, or forwarded to the postmaster of the originating system.

For users who are traveling, Messaging Server provides a Web-based access program called Messenger Express that is somewhat limited in capability. A user can send and receive text-only mail from a Web browser but not open attachments or read MIME-encoded messages. Though it lets you view messages in the store, that doesn't include mail in subfolders. Messenger Express operates on two nonstandard port numbers; one is for unencrypted and the other is for SSL-encrypted transmission. Although this approach helps reduce the likelihood of hacker attacks on the mail Web server, Messenger Server provides no remote-administration capability.—*Les Freed*

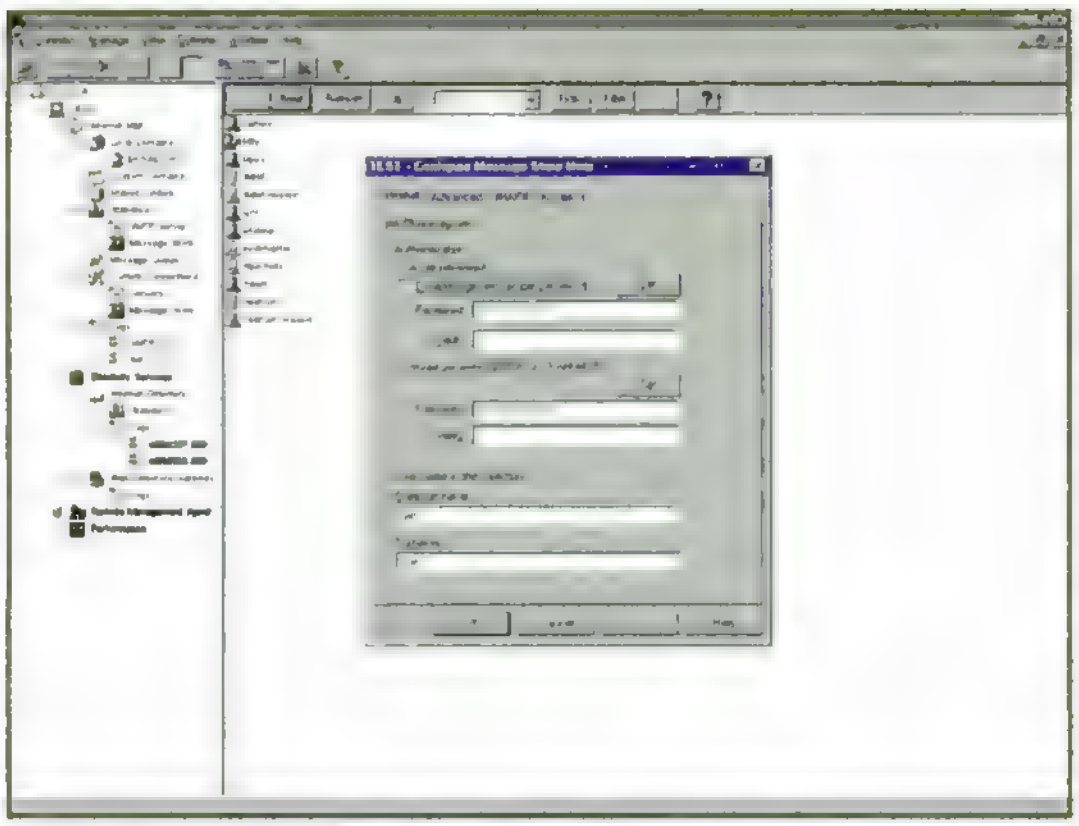
Netscape Messaging Server for NetWare. List price: 50 users, $1,425. Requires: 486-based PC or better, 16MB RAM, NetWare 4.1 or later. Novell Inc., Provo, UT; 888-668-6699; www.novell.com. *Choose 505 at www.pcmag.com/infolink.*

Isocor

N-Plex Office

For the small to midsize business, N-Plex Office 1.31 ($395 list for 20 users) provides rich functionality and includes an LDAP directory server, remote administration, flexible user self-administration, and myriad configuration options for user accounts. But the omission of secure administration and filtering features, as well as the lack of a Web mail client, weakens the product's appeal.

Installation was easy, thanks to excellent documentation, available both online and in print form. Administration is performed from the Isocor Management Center, a Windows NT utility that manages all Isocor products centrally. The two-pane user interface is made for scaling. On the left side, all of the Isocor services are displayed in a collapsible hierarchy. On the right, the members pertaining to the highlighted component appear. A simple search box lets you bring up or filter an address using the first part of the account name. Alternatively, you can expand the right pane to fill a full screen to view additional users.



N-Plex Office's administration screen is laid out in two panes with graphical icons to create, call up, and modify user profiles.

All user information is stored in the Directory Server, which supports LDAP. You can view the server's contents from within the Management Center interface or from an LDAP client. By using the product's Web/Directory gateway, you can also view the contents of the LDAP directory from a browser. The Web interface is somewhat confusing, but it does show you the simple common name, surname, and e-mail address information necessary for administration.

Administrators can set expiration dates for messages and even restrict account usage to certain times of the day, a useful tool for managing temporary workers. You can assign each user a maximum mailbox size and let users create shared folders for posting public information. We felt that permissions are a bit too broad, allowing all users with access to add, edit, and even delete any message from the shared folders.

A flexible auto-reply feature can be implemented from either the user or administrative end. Logs and log file reports are available in order to help administrators keep track of mail server activity.

The Web/Directory gateway provides a spiffy Java interface, which lets administrators and users perform remote management functions. The interface provides configuration options for users, groups, and the entire system, but the lack of a tab function makes entering new users from here tedious. Self-administration options are flexible, allowing administrators to permit users to change passwords, set up auto-reply messages, and choose addresses to which messages should be forwarded. N-Plex users are hampered by the inability to create or read messages from the Web interface, however.—*RPL*

N-Plex Office 1.31. List price: 20 users, $395; 50 additional users, $545. Requires: Pentium-based PC, 32MB RAM, Microsoft Windows NT 3.51 or later. (Hard disk requirements vary by message store.) Isocor, Santa Monica, CA; 310-581-8100; www.isocor.com. *Choose 506 at www.pcmag.com/infolink.*

Internet Shopper Ltd.

NTMail

NTMail 3.03C ($200 list for ten users), from Internet Shopper, is a mail server with modest features. You can download NTMail from Internet Shopper's Web site, along with excellent on-line documentation. (A print manual is also available—for $80.) Although NTMail's filtering and mail store control distinguish it from other products, the server lacks features such as security, LDAP support, and self-administration. And although NTMail appears priced to attract small businesses, features such as list and domain management must be purchased as add-ons (from $200 to $500 each), pushing the price over $1,000 for even a very small group. The only immediate technical support, conducted largely by e-mail, does not suffice.

We found the server easy to install, though we found the program's reliance on individual Control Panel applets for different administrative functions to be

less efficient than a typical unified administrative interface.

NTMail installs four such applets in the Windows NT Control Panel. For example, one applet starts the program and another administers users. NTMail Inspector lets administrators examine individual mailboxes, rename them, and delete individual messages. NTMail Report creates many different types of log reports, including summary and details analyses that are displayed in either text or HTML format. You can either add users manually or import them from the Windows NT User Directory. The optional NTList and NTDomain modules are installed as control panel applets as well.

Although we didn't favor the approach, NTMail's applets are a good way for users with simpler needs to install only the components they need. This can keep costs down and simplify administration by eliminating clutter that won't be used by a particular mail setup.

Users and administrators alike can access the system via a Web browser. Most of the remote administrative functions are displayed on a single screen and are accessed easily by clicking on the appropriate tab.

Like many lower-end servers, NTMail is light on security features. The product does not offer encryption, digital signatures of user passwords, or SSL support but does have a password-protection feature for the postmaster account.

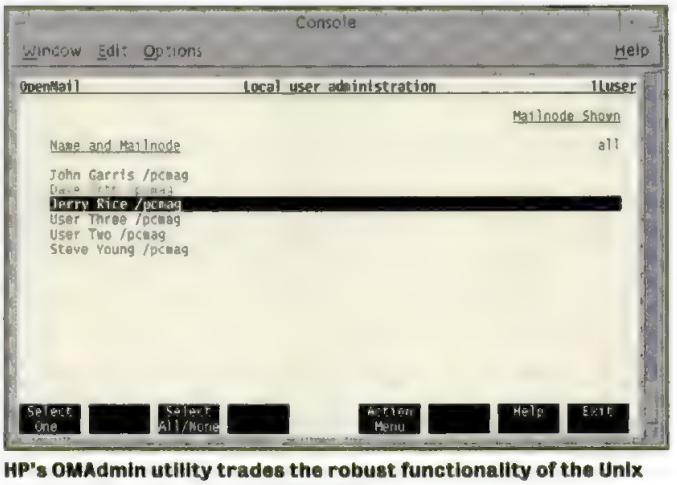
NTMail offers better filtering than most products, however, featuring both IP filtering and message content filtering that references a user-defined text file of banned words. NTMail also provides above-average control over the mail store, including the ability to limit message sizes, mail file sizes, and the number of messages.—*TN*

NTMail 3.03C. List price: 2 users, $60; 10 users, $200; 50 users, $350; more than 50 users, $500. E-mail support, free; priority e-mail support, $125 a year. Telephone support: $350 a year, 9:00 to 5:00 (eastern time), weekdays. Premium support: $2,000, 24 hours daily. Requires: Pentium/90-based PC, 32MB RAM, 25MB hard disk space, Microsoft Windows NT 3.51 SP or Windows NT 4.0 SP3. Internet Shopper Ltd., P.O. Box 79, Clevedon, U.K.; 44-1275-340-333; www.ntmail.co.uk. *Choose 507 at www.pcmag.com/infolink.*

Hewlett-Packard Co.

OpenMail

Unlike the other products in this roundup, which are mostly Windows NT–based and geared to the workgroup, Hewlett-Packard Co.'s OpenMail 5.10 ($3,000 list for 50 users) is a Unix-based enterprise-level mail server gateway. OpenMail is built specifically to bring IMAP features to organizations of 5,000 or more that have either outgrown their current mail architectures or want to implement a single messaging architecture for multiple POP3 and IMAP4 client types.



HP's OMAdmin utility trades the robust functionality of the Unix command line for a more limited GUI.

Admittedly, comparing installations of Windows NT and Unix mail servers is like comparing apples and oranges, but we must note that configuring OpenMail was even more difficult than the average complex Unix program installation. The extensive documentation is available online only, because, according to HP, the print version would exceed 1,200 pages.

We tested the server on a Sun Netra running Solaris 2.6. (OpenMail also runs on HP/UX and IBM AIX Unix platforms.) Although we installed OpenMail with guidance from HP, a typical OpenMail implementation requires either in-house Unix expertise, a team of administrators, or an HP architect. Such an approach naturally makes more sense in environments with tens of thousands of mailboxes.

Although OpenMail provides a terminal-based administration program called OMAdmin, the product lacks much of the power of Unix command-line administration utilities. Novice Unix administrators might find the OMAdmin GUI interface a comfort, though. It lets you add and modify users and *mailnodes* (logical groupings of users) and check the different mail services running on the mail server. But many administrative tasks, such as adding users in bulk and performing consistency checks on the server and user mailboxes, still need to be handled from the command line.

Unlike the other two Unix-based packages we tested, OpenMail does not include an IMAP4 client. We tested OpenMail using both Microsoft Outlook Express and Netscape Communicator. Though we successfully sent, received, and viewed messages, we were unable to view the centralized user directory. OpenMail supports shared folders, but we had to configure a workaround to trick Communicator into displaying them, and we failed to make them appear with Outlook Express.

In addition to IMAP4, OpenMail supports a number of other mail standards and clients. If your company has a variety of mail systems already in place, OpenMail can provide a good integration or migration tool.

OpenMail's security features are limited. While IMAP4 clients connect using an unencrypted log-on, Simeon and Sun Internet Mail Server can use either Kerberos (the log-on security standard) or SSL to encrypt log-ons and message bodies. OpenMail does provide an encrypted log-on feature for other client types.—*John Garris*

OpenMail 5.10. List price: 50 users, $3,000. Requires: IBM AIX, HP-UX, or Solaris operating system. (Requirements vary by platform.) Hewlett-Packard Co., Palo Alto, CA; 800-637-7740; www.hp.com/go/openmail. *Choose 508 at www.pcmag.com/infolink.*

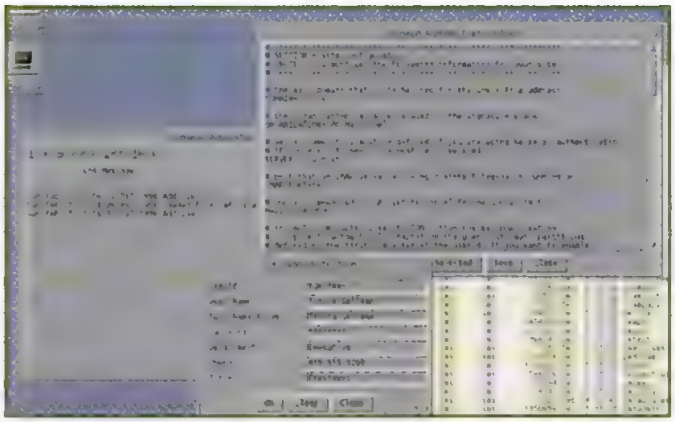
The ESYS Corp.

Simeon Message Service

Although Simeon Message Service 2.0.1 ($6,000 list for 1,000 users) is among the most scalable mail servers in this roundup, the product is also among the most complex to configure and administer. But if

your company has Unix expertise and must support a large mail infrastructure, Simeon is perfect. If you value ease of use and have fewer than 500 users, one of the Windows NT–based packages makes more sense.

Installation, although by no means easy compared with Windows NT servers, was fairly straightforward for this Unix product. Simeon deployment and administration requires an IS professional well versed in both Unix and messaging architectures.



Simeon's administration tool lets you perform basic tasks such as adding new users and printing configuration files.

Documentation consists of an Install.txt file. Even though the contents of the file are expressed clearly, the installation process still took more than 3 hours. The most difficult part involved configuring Simeon to use the sendmail message transfer agent that came with Solaris 2.6. We found the configuration instructions for sendmail to be poorly documented, requiring help from ESYS technical support.

Like HP's OMAdmin, Simeon includes a graphical administration tool called SMSAdmin that displays configuration files and settings. Although you can add and modify users through SMSAdmin, most tasks, such as viewing logs and adding users in bulk, still need to be performed from the Unix command line. ESYS provides an optional LDAP directory server. Without it, the administrator must access user information by taking the time to write an import script.

In addition to the Simeon server, ESYS also provides an IMAP4 mail client optimized for the server. Benefits include the ability to access Internet Mail Sharing Protocol (IMSP) address book information on the server. The address book organizer lets you create public groups and user names, and you can publish those address books for use by other users. You can also create public folders that contain shared messages viewable by all users. As expected, we were unable to view the Simeon address book or shared folders from Microsoft Outlook Express or Netscape Communicator. There is no Web access feature for clients to access mail or for remote administration.

Simeon has a number of security options, but many of them require installation of third-party products. Out of the box, Simeon lets you encrypt log-on information, though only when using the Simeon client. You can configure the Simeon server to use Kerberos for secure authentication, although this requires a third-party program. Simeon does not support SSL for secure message delivery, but will in Version 2.1. You can configure the Simeon client to use Pretty Good Privacy (PGP), but you'll need to bring your own software.—*JG*

Simeon Message Service 2.0.1. List price: 1,000 users, $6,000. Requires: Solaris, DEC Unix, SGI IRIX, HP/UX, AIX, or Linux operating system. (Requirements vary by platform.) The ESYS Corp.; Edmonton, Alberta, Canada; 800-850-0114; www.simeon.com. *Choose 509 at www.pcmag.com/infolink.*

Sun Microsystems

Sun Internet Mail Server

Larger organizations that want to run a mail server on Solaris or are planning to move from a Unix sendmail system should consider the Sun Internet Mail Server 3.2 (Sun IMS) ($1,495 list for 100 users). It runs on Solaris on both Sparc and *x*86 systems and provides both an LDAP directory server and integration with Unix mail. Oddly, Sun IMS lacks the ability to assign multiple domains to one server, a rote feature in most other servers, and one that large organizations and ISPs rely on heavily.

The administration interface is broken into four components: Message Access, Message Transfer, Message Store, and Directory Server. Though each contains separate configuration options and logging facilities, all are well thought out and integrated.

In this version the Directory Server—formerly a separate product—is integrated into Sun IMS. This is great if you make Sun IMS your central directory store, since you can take advantage of LDAP by exporting user information to other applications. But there is no good way to use an external LDAP directory.

You administer Sun IMS using Sun's HotJava browser, either from the mail server or from a remote system. (At present, neither Netscape Navigator 4.0 nor IE 4.0 is compatible with the Java administration environment without patches.)

Security is light, with optional SSL support available only between the administration browser and the server and between Sun IMS and the mail client. Administrative chores can be performed securely using Unix or Win32 encryption from a HotJava browser. The message store can be controlled by size only, and there is no IP filtering or user access to mail via a browser.

The list server feature lets administrators create user groups similar to those of N-Plex, but Sun IMS makes the group and member information accessible through the LDAP directory as well. There is limited self-administration capability; users can view lists of groups and members using a Web browser, but they can't self-subscribe. The administrator can delegate a group's management to a user by providing the user with a password, however.

For administrators migrating their mail systems from Unix var-based mail to SMTP, you can direct the Message Transfer Architecture (MTA) at a var directory mail store, which obviates the need to migrate that mail store to Sun IMS. Sun has made an effort to ease the transition for administrators familiar with the Unix sendmail e-mail program: The Sun IMS administrative interface is similar to that of sendmail.—*RPL*

Sun Internet Mail Server 3.2. List price: 100 users, $1,495. Requires: Sparc- or Intel-based PC, 64MB RAM, 70MB hard disk space, Sun Solaris 2.51 or later. Sun Microsystems Inc., Palo Alto, CA; 800-786-7638; www.sun.com/sims. *Choose 510 at www.pcmag.com/infolink.*

Groupware

Lotus Development Corp.

Lotus Domino, Lotus Notes Designer; Lotus Notes Desktop

Lotus Domino and Lotus Notes continue to set the pace in the groupware market and again this year earn our Editors' Choice. Version 4.6a may seem to be but a small incremental advance toward Internet integration, but Lotus continues to hold its lead in most other areas as well. But with competitors such as Microsoft Exchange Server gaining ground, Lotus will need to go beyond simply keeping pace with customer demands. That's how the leader in a market stays the leader.

One area in which there's no question about improvement is pricing. Lotus's prices certainly have come down over the years for Lotus Notes Desktop ($65 list), Lotus Notes Designer ($495 list), the single-processor version of Domino ($1,495 list), and the SMP version of Domino ($2,295 list).

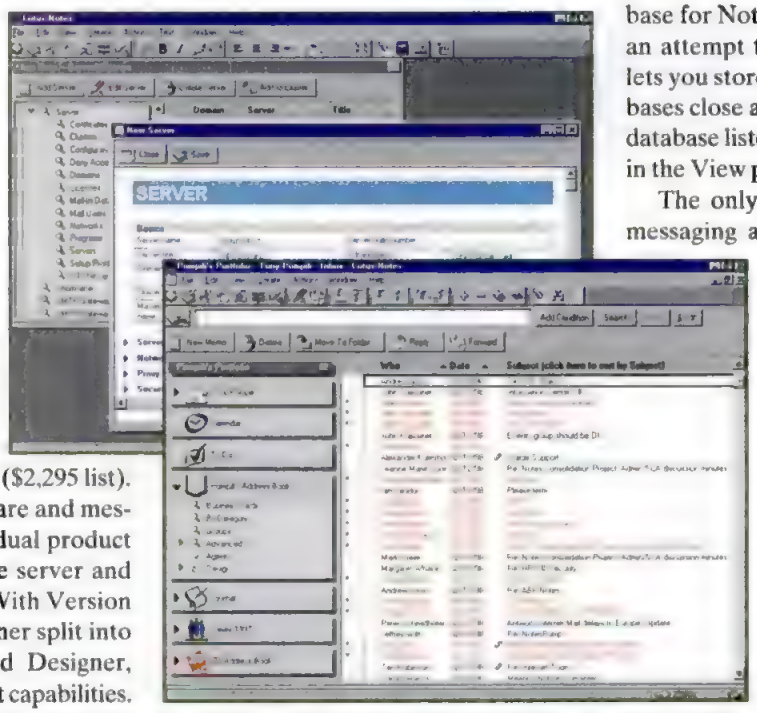
Lotus divides its groupware and messaging units into two individual product lines: Lotus Domino for the server and Lotus Notes for the client. With Version 4.6a, the Notes client is further split into two products: Desktop and Designer, which adds new development capabilities.

Like its predecessors, Domino 4.6a comes in single-processor and SMP versions. For users who want mail only, Lotus sells Domino Mail Server ($995 list). The other groupware products to offer a separate mail server are Microsoft Exchange and Netscape SuiteSpot. Domino runs on many different OS platforms, including IBM AIX, NetWare, OS/2 Warp, Windows NT, and a variety of Unix flavors—making it the most flexible mail server for mixed environments in this roundup.

TRIED-AND-TRUE GROUPWARE

Although this latest version adds a wide variety of rich Internet capabilities, Notes is still Notes. It continues to provide powerful rich-text messaging and flexible discussion capabilities. Notes is still based on a unique decentralized architecture that uses Lotus's unmatched database-replication engine to distribute and synchronize document-based databases from site to site and between a server and a remote user.

Cosmetically, the Notes client has changed little since its inception. You'll still find the old folder tabs and ambiguous command names such as Actions on the menu bar. Although Notes has features that continue to stand out in a crowd, its interface is much less intuitive than those of its competitors—particularly Microsoft Outlook 97 and TeamWare Office.



Domino uses the Notes Name and Address Book to configure routing, replication, and server security. Notes 4.6a's Portfolios feature lets you put your frequently used databases within easy reach.

We also found Domino's administrative tools beginning to show their years. The server console includes many remnants of bygone text-based days. The names and address book would benefit from a hierarchical organization as in Exchange Directory. Whereas most administration is still admirably centralized around the Notes Address Book, we would like to see some improvements made in this area.

Even so, Domino and Notes continue to provide RSA-based security unmatched by the competition. Lotus has always been a forward thinker here, and Domino and Notes are the only groupware programs that require such authentication before a client can connect to a server. Applications such as Netscape SuiteSpot provide server-based security as an option only. For user Web access, Notes uses password authentication with SSL data encryption.

Lotus has made a few minor interface changes with Version 4.6a that seem geared to PIM enthusiasts. We liked the new Personal Portfolio, ostensibly a database for Notes databases. The Portfolio, an attempt to keep pace with Outlook, lets you store your commonly used databases close at hand. When you click on a database listed in the Portfolio, it appears in the View pane.

The only weakness in Notes on the messaging and collaboration front is a lack of document management features. The package contains some basic templates, but the rest is left to third-party development.

THE INTERNET AND DEVELOPMENT

New to Version 4.6a is an expanded range of Internet service options that support POP3 and IMAP4 Internet mail, as well as Internet Relay Chat (IRC) and LDAP. Also new to this version is the capability for users to access mail from the Notes client and any POP3 mail client, a feature we found convenient and easy to set up.

We continue to like the Notes Web client, introduced in Lotus Notes 4.0 and improved with Version 4.5. Using Microsoft Internet Explorer 4.0 or the Notes browser, you can save entire Web pages and manipulate them as you would other Notes data. You can send off a Web page and it will arrive at its destination,

The Next Notes

Lotus plans to ship Lotus Domino 5 and Notes 5 in the second half of 1998. The new versions will merge Lotus's many messaging clients into one while completely separating the development environment from the client. A key focus will be the new realm of "knowledge management."

Upon opening the new Notes client, most users will see the Headlines page, which is a customizable view of important information. The Notes version we saw replaced the traditional Workspace page with Portfolios, an aggregation of databases introduced in Version 4.6. Lotus has also revamped its Web browser with support for HTML4.

Domino Designer 5 fulfills the desire of application developers for a standalone development environment for both Notes and the Web. In addition to improved tools for building apps, Designer also introduces new design elements, such as outlines and framesets.

Domino 5 will include administration tools with a cc:Mail-style interface, online incremental backup and mailbox compaction, 16GB databases, and support for more than eight processors.

One of the buzzwords around Domino 5 is knowledge management: tools for making large amounts of information stored in various locations easily available. To this end, Domino 5 plans major improvements to searching and cataloging features.—*Ben Z. Gottesman*

links intact. But our tests showed that the ActiveX-capable IE4 rendered Web pages more accurately than did the Notes browser. (Lotus bundles both IE4 and Netscape Navigator.)

With this version, Lotus also introduces the Web Administrator, which makes it possible for the Notes administrator to view and configure many basic standard parameters, as does SuiteSpot. Also new to Domino are its IMAP4 mail and LDAP directory services. LDAP promises to facilitate interchanging directory information with disparate messaging systems, such as Exchange or GroupWise. And by integrating the SMTP MTA directly into Version 4.6a, Lotus brings Notes one step closer to SMTP-based native routing, expected in Notes 5.0 (for more information, see "The Next Notes").

Lotus's vision for making Notes a one-stop development platform for Web and messaging applications is more focused in this version. The new Designer client gives you all the functionality of Desktop, plus some specific development tools. Designer removes the arcane field-naming conventions previously used to add Notes components to Web pages. We also liked the new preview mode that makes it easier to view a Notes form as it is being rendered.

Notes Designer also lets you add Java applets to Notes and Web applications running from the server and to the Notes client. Lotus's unique environment—made up of macro language, BASIC-like LotusScript, and object-oriented forms—provides one of the tightest and richest sets of application development, debugging, and testing tools available.—*Tony Pompili*

Lotus Domino 4.6a. List price: Single-processor version, $1,495; SMP version, $2,295. Requires: AS/400 or OS/390. **Lotus Notes Designer 4.6a.** List price: $495. **Lotus Notes Desktop 4.6a.** List price: $65. Requires: For server: IBM OS/2 Warp, IBM AIX, Microsoft Windows NT 4.0, Windows 95, NetWare, or Sun Solaris 2.5 or later; for client: IBM AIX, Microsoft Windows 95, Windows NT Workstation, or Sun Solaris 2.5 or later. Lotus Development Corp., Cambridge, MA; 800-343-5414; www.lotus.com. *Choose 512 at www.pcmag.com/infolink.*

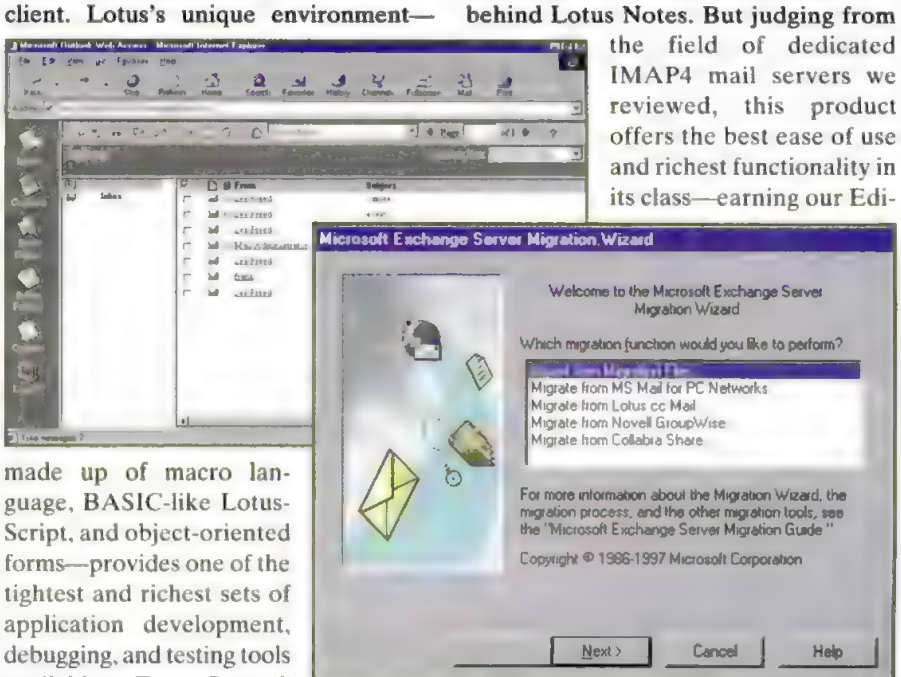
Microsoft Corp.

Microsoft Exchange Server

PC MAGAZINE EDITORS' CHOICE

The latest release of Microsoft Exchange Server (Standard Edition, $999 list for 5 users; Enterprise Edition, $3,549 list for 25 users) demonstrates the importance of Internet connectivity in groupware's evolution. Version 5.5 provides a full-featured IMAP4 server, an LDAP directory service, and Web access to mail, scheduling, and discussion features. There are also several new tools for writing Web applications, including a scripting engine based on Internet Information Server (IIS).

As a groupware package, though, Exchange still finds itself a length or two behind Lotus Notes. But judging from the field of dedicated IMAP4 mail servers we reviewed, this product offers the best ease of use and richest functionality in its class—earning our Edi-



Exchange's Web access bears an uncanny resemblance to Outlook but lacks the Notes and Journal functions. Want to move to Exchange from another product? Data and user migration wizards make the task manageable.

SUITABILITY TO TASK: GROUPWARE

	Lotus Domino 4.6a	Microsoft Exchange Server 5.5	Netscape SuiteSpot 3.5	Novell GroupWise 5.2	TeamWare Office 5.1
Administration	Good	Excellent	Good	Fair	Excellent
Messaging	Excellent	Excellent	Good	Good	Excellent
Collaboration	Excellent	Good	Good	Excellent	Good
Security	Excellent	Excellent	Excellent	Good	Good
Remote access	Excellent	Good	Good	Excellent	N/A

N/A—Not applicable. This product does not provide remote access.

We evaluate groupware systems by comparing them component for component, with an emphasis on e-mail. Although in many cases we judge groupware and mail servers using the same criteria, in a few instances we use different criteria under the same heading. In evaluating administration for groupware, for example, we look at a product's centralized directory and how it lets you set up users for multiple modules (such as discussion and mail), whereas in evaluating administration for mail servers, we look at a product's mail directory only. A groupware package that fares well against mail servers does not necessarily rate as highly when compared with its groupware competition.

Administration We evaluate the setup and management of the system. The package should have one centralized directory for all components. We also look for integration with network operating system directories. Creating new users and groups should be straightforward, and remote-administration tools are a plus.

Messaging Here we examine both the server and the proprietary messaging client. The server software should let you limit the mail file store by size and number of messages, and client software should support rich text. Users should be able to organize mail into folders and subfolders. Client-side ease of use is also important.

Collaboration We look at discussion, scheduling, real-time chat, and document-revision control. Discussions should be threaded and let you embed attachments. There should be moderation controls specific to each discussion. For scheduling, we look for the ability to create personal and group meetings and check for conflicts.

Security Support for SSL is important. We prefer systems with built-in security over those that rely on the security features of the network operating system. We look for security features for remote users as well.

Remote access Remote users should be able to access most of the groupware features when they log on. We look for the ability to replicate information to a local drive and work off-line. When users reconnect after off-line work, the application should synchronize easily. We also consider how the package lets you share information via the Web client.

tors' Choice in that category.

Exchange is available in two versions. We tested the Enterprise Edition, which includes support for server clustering and e-mail gateways for X.400, IBM Office Vision/VM, and SNADS. Whereas other groupware products have optional gateways, Exchange includes more of them than you'll find in any other groupware or mail server product. Additional client licenses cost $492.30 (list) per ten-pack.

GETTING STARTED

We found Exchange one of the most sophisticated products in our groupware roundup but also one of the easiest to install and maintain. Before you begin, though, you must install the Windows NT 4.0 Option Pack (free for download from Microsoft's Web site) to get Active Server Pages (ASP) functionality. The download is small, and the pack is now included as part of Windows NT Server 4.0. Besides ASP, the pack installs necessary components such as Windows NT 4.0 Service Pack 3, IIS 4.0, and Internet Explorer.

The wizard-based installation took just under 30 minutes to complete. Adding users is easily done, either by importing data directly from a NetWare NDS directory or from a Windows NT Server domain. This approach is a considerable time-saver, making Exchange an attractive choice for large organizations. The Exchange user database is closely linked to the Windows NT user directory. Each user must also have a valid Windows NT user account, which lets Exchange utilize its security services. This lets users access network services and mail with the same user name and password.

Administration chores are handled through the Exchange Administrator. The program presents a tree view of all Exchange objects and services; a right mouse click on any item lets you view and

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edit its properties. Like Notes and TeamWare Office, Exchange provides a high degree of control and customization for each user. For example, you can enable or disable Web access, IMAP, SMTP, and NNTP access on a per-user or group basis.

Exchange also lets you set a storage-size limit and even a time limit on stored messages on a per-user, systemwide, or groupwide basis. (GroupWise is the only other program to offer this degree of control.) The product lets you give any user send-as or send-on-behalf-of rights for another user, which makes it easy to cover for an absent colleague.

MESSAGES AD INFINITUM

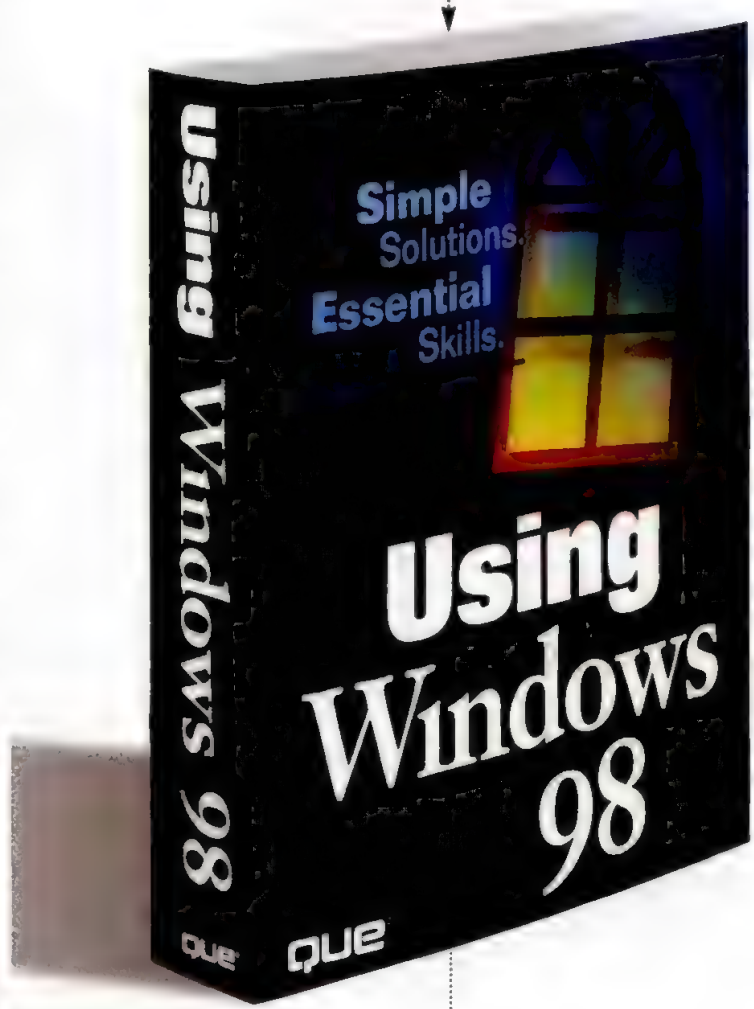
Exchange has Microsoft Outlook 97 as its client. (According to Microsoft, by the time you read this, Outlook 98 will be the bundled client.) Although this server lets you access your mail with any IMAP or POP3 mail client, you'll want to use Outlook to take full advantage of Exchange features.

Exchange's IMAP4 and SMTP servers worked flawlessly with all our test clients. The SMTP server includes a clever feature called Smart Host which, when necessary, forwards outbound mail to a third-party SMTP server. If you often rely on an ISP for your outbound SMTP mail relay, this feature can save time and money by letting you send mail over the corporate WAN whenever possible.

The Enterprise Edition is the only groupware product that claims a theoretically unlimited message store, restricted only by your disk capacity. To achieve this infinite store, several Exchange servers can work together using Microsoft's Windows NT clustering technology.

Exchange's calendar provides the best free-time checking feature we've seen, so it's easy to see if colleagues are available before you invite them to a meeting. Exchange also offers robust discussion features that you can access with any NNTP client. There are no document management, check-in/check-out, or versioning capabilities, but Exchange offers good control over shared folders. They can contain any file type, and you can assign each a public or private status. You can also store shared folders on a second Windows NT server to reduce the storage burden. A lack of versioning will make it difficult to share documents among many users, however.

Using



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SUMMARY OF FEATURES — See www.pcmag.com for interactive views

Groupware

Continues

■ YES ▨ NO	Lotus Domino 4.6a (PC MAGAZINE Editors' Choice)	Microsoft Exchange Server 5.5* (PC MAGAZINE Editors' Choice)	Netscape SuiteSpot 3.5	Novell GroupWise 5.2	TeamWare Office 5.1
List price	$1,495.00 per server	Enterprise Edition, for 25 users, $3,549; Standard Edition, for 25 users, $2,129	Professional Edition, $140 per user; Standard Edition, $82 per user	For 10 users, $1,421	For 5 users, $1,495
Servers					
Operating systems supported:					
Microsoft Windows NT Server 3.51/4.0	■■	■■	■■	■▨	■■
NetWare 3.1x/4.11	■■	■▨	■■ (via Novonyx)	■■	■▨
OS/2 Warp Server 4 / AIX	■■	■■	■■	■■	■▨
HP-UX/Solaris	■■	■■	■■	■■	■■
Server or bundle includes:					
Web server or equivalent HTTP services	■	■	■	■	▨
Newsgroup server or equivalent NNTP services	▨■	▨■	■■	▨▨	■■
POP3 / IMAP4 server or equivalent services	■■	■■	■■	■■	■■
Internet protocols supported by servers:					
Lightweight Directory Access Protocol (LDAP)	■	■	■	■	■
Secure Sockets Layer (SSL) 2.0/3.0	■■	■■	■■	■■	▨▨
Simple Mail Transfer Protocol (SMTP)	■	■	■	■	▨**
Network protocols supported by servers:					
TCP/IP / IPX/SPX	■■	■■	■▨	■■	■▨
NetBIOS/NetBEUI	■■	■■	▨▨	■■	▨▨
Other Clients					
Native client available for:					
Microsoft Windows 3.x, 95, and NT Workstation 4.0	■	■	■	■	■
Macintosh / OS/2 Warp / Unix	■■■	■■▨	■■■	■▨■	▨▨▨
Native client includes integrated:					
Web browser	■	▨	■	▨	▨
Newsgroup reader	■	▨	■	▨	▨
POP3 / IMAP4 e-mail reader	■■	■■	■■	▨▨	■■
User can access e-mail/discussions using a Web browser	■■	■■	■▨	■■	■■
Messaging					
Native client's single in-box view can include:					
E-mail messages/Voice mail/Faxes	■■■	■■■	■■■	■■■	■▨■
Calendar events/Tasks	■■	■■	■■	■■	■■
Native client's e-mail contents can include in-line:					
Rich text/Graphics/Forms	■■■	■■■	■■■	■■■	■■■
Clickable URL links/OLE 2.0 objects	■■	■■	■■	■▨	■■
Server supports MIME / S/MIME attachments	■■	■■	■■	■■	■▨
Server supports uuencode attachments	■	■	■	■	■
Administrator can customize forms	■	■	■	■	■
User can customize fonts	■	■	■	■	■
User can set server-based/client-based rules	■■	■■	■■	■■	■■
User can delegate access to a private mailbox	■	■	■	■	■
User can view delivery route	■	■	■	■	■
Native client allows LDAP address lookups	■	▨	■	■	▨
Collaboration					
Threaded discussions to infinite levels	■	■	■	■	■
Moderated discussions	■	■	■	▨	■
Types of searches:					
Boolean	■	■	■	■	■
By data store/topic/full text	■■■	■■▨	■■■	■■■	■■■
Agents can be created to search for specific topics	■	▨	■	▨	▨
Discussion documents can include in-line:					
Rich text/Graphics/Forms	■■■	■■■	■■■	■■■	■■■
Clickable URL links/OLE 2.0 objects	■■	■■	■■	■■	■■

* Microsoft Exchange Server 5.5 is the Editors' Choice as a mail server. ** TeamWare includes a 30-day trial version of a third-party SMTP server.

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SUMMARY OF FEATURES

Groupware

Ends

■ YES □ NO	Lotus Domino 4.6a (PC MAGAZINE EDITORS' CHOICE)	Microsoft Exchange Server 5.5* (PC MAGAZINE EDITORS' CHOICE)	Netscape SuiteSpot 3.5	Novell GroupWise 5.2	TeamWare Office 5.1
Scheduling					
Scheduler allows user to					
View schedule by users/groups	■■	■□	■■	■■	■■
Schedule groups/resources	■□	■■	■■	■■	■■
Create links to e-mail/documents	■■	■■	□■	□■	■■
Create links to discussions	□	■	□	■	■
Searches for free time slots of invitees	■	■	■	■	■
Synchronization					
Clients can replicate message/calendar	■□	■■	■■	■■	□□
Clients can replicate documents	■	■	□	□	■
Supports synchronization at folder/document/field level	■■■	■□□	■■■	■□□	□
Client synchronization can operate bidirectionally/in background	■■	□□	□□	■■	■■
Document Management					
Check-in/Check-out	□□	□□	■■	■■	■■
Concurrency control/Versioning	[illegible]	[illegible]	■■	■■	■■

* Microsoft Exchange Server 5.5 is the Editors' Choice as a mail server

VIEW FROM THE WEB

Exchange works hand in glove with IIS to provide Web-based access to mail, calendar, and discussion databases. We were impressed with how closely Exchange's Web view resembled the Outlook 97 interface, letting users experience a near-seamless transition from the proprietary client to a Web-based one.

Like the other groupware products, Exchange provides only a subset of Outlook's proprietary mail features. Though mail and calendar applications are accurately reproduced in HTML and Java in the Web client, you'll lose Outlook's Journal, Notes, and Task List features. But we found it easy to send and receive mail and create and review appointments from the Web client. Not surprisingly, unlike GroupWise and TeamWare, the Web server connected smoothly to both IE 3.0 and IE 4.0, as well as to Netscape Navigator 4.0.

Although the Web server provides good support for remote users, there's no Web-based remote administration. User authentication is performed using Microsoft's authentication protocol, but SSL isn't provided when you connect via the Web client. Exchange includes a replication feature, though it requires off-line users to replicate the entire data directory. This implementation is neither as easy as the one-button approach of GroupWise nor as flexible as Notes, which lets you copy selected data. —*LF*

Microsoft Exchange Server 5.5. List price: Standard Edition, 5 users, $999; Enterprise Edition, 25 users, $3,549. Requires: Microsoft Windows NT 4.0. Microsoft Corp., Redmond, WA; 800-426-9400; www. microsoft.com/exchange. *Choose 513 at www.pcmag.com/infolink.*

Netscape Communications Corp.

Netscape SuiteSpot

Unlike the other groupware products, which have had standards support added to their proprietary systems, SuiteSpot was built by Netscape from the ground up using Internet standards. This makes it the first choice for organizations absolutely committed to a standards-based architecture. New features in Version 3.5 include a new document-sharing environment, Web-based calendaring, and much-improved user and group management. Substantial improvements have also been made to the administration server. Pricing per user is comparable to that of other groupware packages: $82 list for the Standard Edition and $140 list for the Professional Edition. SuiteSpot's Standard Edition provides Web, collaboration, and directory functions, whereas Professional Edition includes richer administrative capabilities as well as a certificate server and advanced information-cataloging and search features. We tested Standard Edition, which comprises Netscape Communicator and five Web-based servers: Calendar Server 3.5, Collabra Server 3.5, Directory Server 3.0, Enterprise Server 3.5, and Messaging Server 3.5.

Though you can purchase the servers separately, Netscape has succeeded in making the whole greater than the sum of its parts, with fine centralized browser-based administration and well-integrated user and group management functionality. SuiteSpot servers run on Windows NT as well as Sun Solaris and a variety of other Unix platforms, making this an excellent choice for cross-platform networks.

ONE DIRECTORY FOR ALL

Installation took about an hour. Setting up users and groups is accomplished with the Netscape Directory Server, which handles user management for all the servers. Adding users and groups was easy, but we found setting access controls complicated and confusing. The access-control interface is clumsy and relies heavily on a knowledge of LDAP syntax. We prefer the LDAP implementations in Domino and Exchange.

Though the online help is good, and Directory Server's integration is much improved over previous versions, we found the access-control administration experience somewhat tricky. The interface caused JavaScript errors if we moved too many windows, and at times Communicator crashed, perhaps indicating faulty JavaScript.

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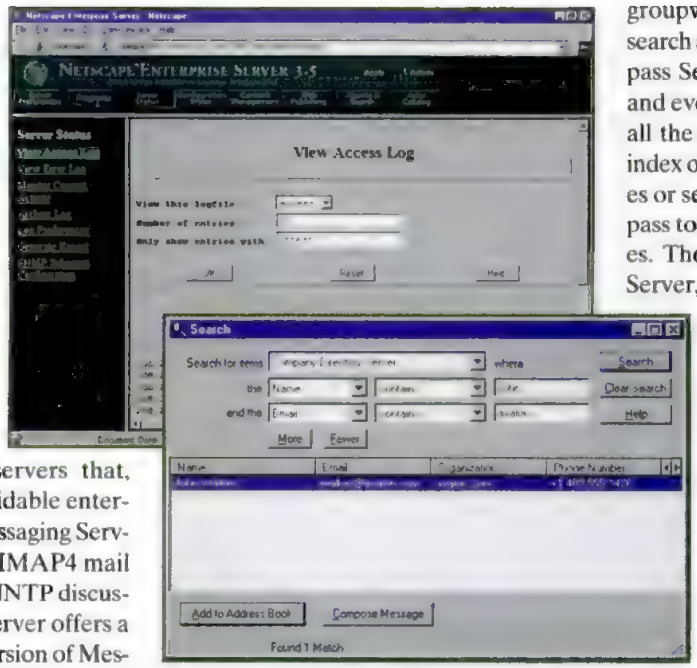
The replication model for setting up multiple directory locations is simple to use. Most companies will find that best performance is gained by using a single-master Directory Server, with feeds to secondary servers in different regions. Directory Server lets you distribute among multiple servers and then set up replication rules between them.



In SuiteSpot, each server includes its own management interface for server-specific configurations. You can search the Directory Server from any LDAP client, including Netscape Navigator's search utility.

COLLABORATION, OPEN-STYLE

SuiteSpot provides three servers that, taken together, make a formidable enterprise groupware solution. Messaging Server supports both POP3 and IMAP4 mail clients, Collabra Server has NNTP discussion groups, and Calendar Server offers a group scheduler. This new version of Messaging Server includes the Web-based client Message Express. For those using the Messenger client, security is provided through SSL. Users who care about security can secure messages on the client side with S/MIME or PGP encryption.

Collabra Server remains unchanged from previous SuiteSpot iterations, providing standard NNTP threaded-discussion capability as well as access to Usenet discussion feeds. It lets you use any NNTP client to access the server, and you can set up both public and private discussions. The discussion-group client in Netscape Communicator can use SSL to connect securely with Collabra Server and maintain private discussions over an extranet. Calendar Server and Calendar Client form a good scheduling system. You can set up multiple servers for different regions or a central server. But calendaring is the bug in Netscape's open-standards ointment. The Calendar client is proprietary and is included in the Professional version only. Though Calendar Express is part of the standard version of Communicator and works in any browser, it lacks the full features and cleaner interface of the full Calendar client. Though Express lets you read and create schedule entries, we found the HTML/Java interface less effective than the Windows calendaring clients you'll find in other groupware systems—but about on a par with those of the Web-based clients.

If you're ready to explore the use of digital certificates as an authentication method, you can use Certificate Server—available separately or as part of SuiteSpot Professional. It lets you manage and revoke certificates, and we found it easy to implement in internal communications.

WORKING FROM THE WEB

Version 3.5 introduces NetShare, a virtual workspace that lets users publish, share, and view group data from a dedicated Web address. Users can upload and download documents into public and private areas and set access control for their own workspaces. It's a good way to share documents with others, providing similar functionality to a class of teamware products we reviewed earlier ("Instant Groupware," February 10, 1998).

We liked NetShare's approach to document sharing, but the interface took some getting used to. For example, we found its inability to minimize a utility window quite distracting. But this interface wasn't nearly as troublesome to use as the administration interface. NetShare's document management features are superior to those of Exchange and Notes but aren't as complete or polished as those in GroupWise or TeamWare.

SuiteSpot Professional is the only groupware package to include a complete search application. You can point the Compass Server at your internal Web servers and even Internet sites, where it will fetch all the information and build a complete index of the data. You can search the indexes or set up preferences that enable Compass to send updates matching your choices. Though Exchange includes an Index Server, it can search only a single server.

SuiteSpot provides a fine replication capability for working offline with e-mail or discussions. Since the package is standards-based, you can use any IMAP or NNTP client to access all your e-mail and discussions.—*RPL*

Netscape SuiteSpot 3.5. List price: Standard Edition, $82 per user; Professional Edition, $140 per user (minimum 50 users). Requires: For Standard Edition: 64MB RAM (128MB recommended), 500MB hard disk space, Windows NT 3.51 or later or Unix; for Professional Edition: 128MB RAM, 740MB hard disk space, Windows NT 4.0 or later or Unix. Netscape Communications Corp., Mountain View, CA; 650-937-2555; home.netscape.com. *Choose 514 at www.pcmag.com/infolink.*

Novell Inc.

Novell GroupWise

In its newest incarnation, Novell GroupWise 5.2 ($1,421 list for ten users) gains some important Web-connectivity features, including browser access, IMAP and POP3 servers, and LDAP support. These features bring open access to the already comprehensive GroupWise suite of mail, scheduling, and conferencing tools.

There's a lot to like in the excellent GroupWise mail and document management features, but on our tests, we encountered several serious installation and operation obstacles. Although Novell was able to provide patches and technical help to guide us through the brambles, we'd recommend this version of GroupWise principally to organizations committed to NetWare. But this package will serve you well after the install.

Before you begin, however, you must download a 50MB patch file for your IntranetWare 4.11 server. This took us an hour, but you'll need an even larger down-

load for older versions of NetWare. None of GroupWise's competitors requires a patch to the server (though you gain some additional Web functionality for Microsoft Exchange by downloading part of the Windows NT 4.0 Option Pack).

So although we had all the other groupware products up and running within an hour, even the smoothest GroupWise install took several hours to complete. And our experience was anything but smooth. The installer repeatedly crashed most of our test clients halfway through the process. With help from Novell's technical-support department, we fixed the problem—which was caused by a truncated DLL file—and after about 14 hours of installing, disk swapping, and server rebooting, we earned ourselves a functional GroupWise system.

TROUBLE WITH CLIENT32

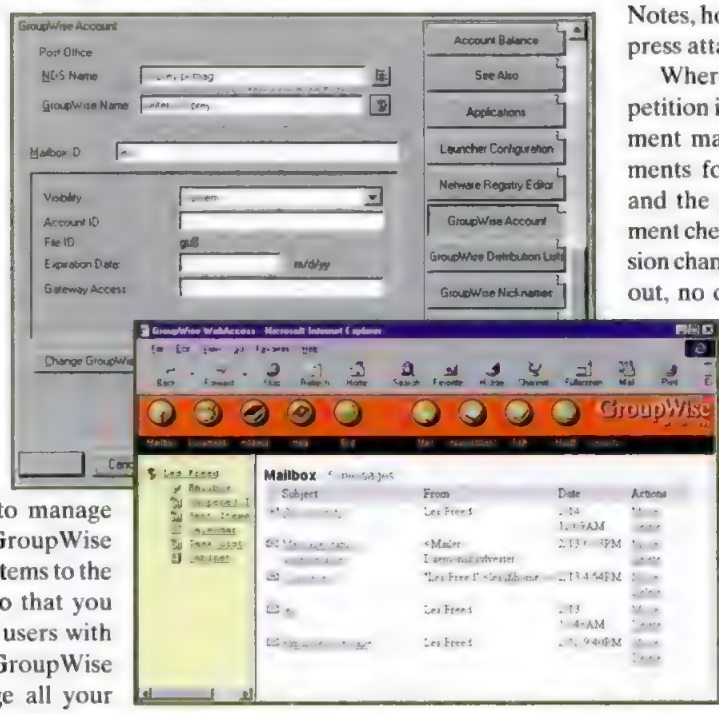
Creating and maintaining user accounts and other administrative tasks are accomplished with the same NWAdmin program used to manage NetWare LAN accounts. GroupWise adds some program-specific items to the NWAdmin menu system, so that you can administer both sets of users with one tool. If you're running GroupWise with NDS, you can manage all your users from any PC on the LAN.

Once the server is set up, it's time to install the GroupWise client software. During server installation, GroupWise conveniently places the client files on the network, which saves you having to install them each time from disk. We found the client installation fast and easy. But with GroupWise, you must administer the system using the 32-bit NetWare client Client32. So if you're using the standard Windows NetWare client, you must first install Client32, then reboot and install GroupWise.

Just when we thought our setup problems were over, installing Client32 caused us a new round. One of our test machines refused to boot, so we had to remove the Client32 driver in Safe Mode to restore the PC to working order. Replacing the system's Bay Networks Ethernet card with a 3Com card fixed the problem, but it's not clear why. We also found that running GroupWise and Microsoft Outlook 97 on the same system caused it to crash repeatedly.

WORTH THE WAIT

Installation difficulties aside, GroupWise has a lot to offer. Though the mail client isn't as flashy as that in Outlook 97 or TeamWare Office, it was simple to use and full of welcome features. There's a message-preview window and an excellent rules manager that lets you apply rules-based actions to incoming messages and calendar appointments. You can sort your mail by multiple fields, and discussions are displayed in a tree view. Microsoft Exchange Server and TeamWare Office have rules managers, but their capabilities are limited in comparison.



The main administration control in GroupWise makes simple work of setting user profiles and parameters. The WebAccess module lets you access most GroupWise features from a browser.

The package helps an administrator grant multiple users partial or full access to a user's mailbox, calendar, or other GroupWise objects, making data sharing quick and easy. You can add formatting to text, but there's no ability to paste a graphic into the message, as there is with Lotus Notes, Outlook, or TeamWare.

GroupWise's new connectivity features bring it more in line with Exchange and Notes. GroupWise includes Internet mail servers that provide easy-to-install IMAP4, LDAP, POP3, and SMTP protocols. They run as a series of NetWare Loadable Modules (NLMs) on the IntranetWare server.

Administration of IMAP and POP mail is linked to the GroupWise mail accounts, so you don't have to maintain two separate user databases. The SMTP server provides full MIME support, letting you send MIME-encoded message attachments from any IMAP or POP3 client. Unlike Notes, however, GroupWise cannot compress attached files or library documents.

Where GroupWise outshines the competition is in its simple yet powerful document management. You can post documents for distribution or collaboration, and the program lets you control document check-in and check-out as well as version changes. While a document is checked out, no one else can make changes to it until the user checks it back in. We also liked the workflow add-on, GroupWise WorkFlow Professional ($149 list, $69 with GroupWise), which uses a drag-and-drop interface for creating rules for document distribution and workflow.

ON THE WEB, ON THE ROAD

With a few limitations, the GroupWise Web server lets you access GroupWise documents from any Web browser. The Web server offers a choice of calendar views: a standard HTML-only display or a Java-enhanced server aptly named WebAccess. Both let you send and receive messages, schedule appointments, and view your address book through an attractive interface that closely resembles the Windows GroupWise client. The HTML view provides a simple, one-day view of appointments, while the WebAccess view offers a full-screen display of the month; clicking on a date pops up the day's meeting schedule.

The WebAccess module worked better with Netscape Communicator than with Microsoft Internet Explorer. IE lets you download file attachments from messages received, but it doesn't let you include attachments to messages you send. But a patch is available on

Microsoft's Web site as a remedy.

For off-line work, a Hit the Road wizard easily replicates your mail and calendar databases into your notebook. It also lets you dial in to your office system to send and receive updates. This quick, one-button approach was the easiest replication tool we tested.—*LF*

Novell GroupWise 5.2. List price: 10 users, $1,421. Requires: For server: Pentium-based PC or better, 48MB RAM, 100MB hard disk space, NetWare; for client: Pentium-based PC or better, 32MB RAM, 100MB hard disk space, Microsoft Windows 95. Novell Inc., Orem, UT; www.novell.com/groupwise. *Choose 511 at www.pcmag.com/infolink.*

Fujitsu Software Corp.

TeamWare Office

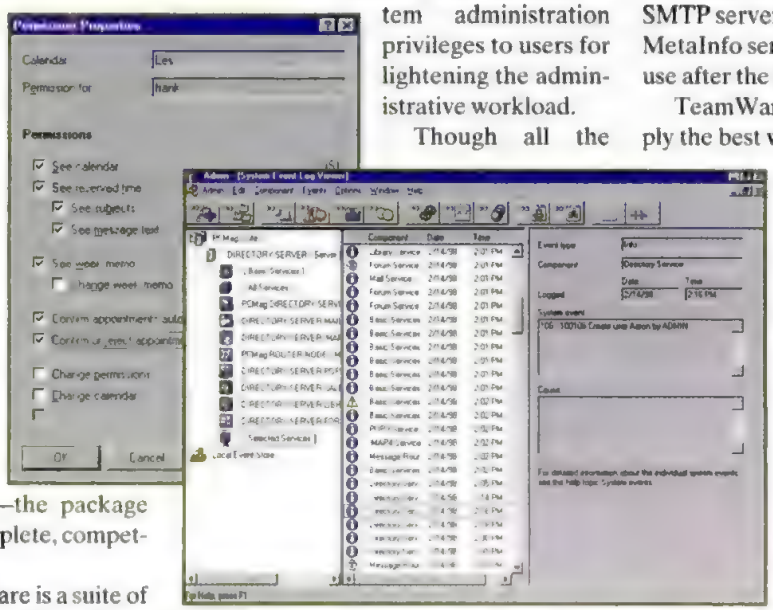
The name TeamWare Office ($1,495 list for five users), from Fujitsu Software, may not resound in the marketplace the way Exchange or Notes does, but it's one you'll want to remember. This groupware product provides excellent e-mail, calendar, and document sharing wrapped in an attractive, easy-to-understand user interface. Though lacking in features that would make it more attractive to large organizations and remote users—such as the ability to import users from the Windows NT user directory or to work off-line—the package nonetheless provides a complete, competitive groupware solution.

Like SuiteSpot, TeamWare is a suite of separate applications. We found the TeamWare installer to be a well-executed, all-in-one utility that installs either the server or client software on any PC. Wizards helped to speed us through a record-breaking install: The server installation took 15 minutes, and the Web Access module and client software each took 10 minutes—for a total of 35 minutes. This was far and away the easiest groupware installation we've ever experienced. An ability to install only selected applications speeds the configuration even further.

Though the install is fast, adding users slows down the process considerably. Instead of reading directory information from the Windows NT User database like other products, TeamWare requires you to create a proprietary user database (called the TeamWare Directory) and to import users from it into the system. This can be a big hassle, particularly for large companies, and may steer some away altogether.

There are, however, long-run benefits to this approach. The TeamWare Directory program includes user profile templates for storing detailed user information that ultimately make maintaining user accounts easier. The Directory consists of various templates that you can customize by department—for example, one for Accounting, another for Sales. Each template contains detailed information that is automatically applied to each user account when it's created using a given template. It also lets you assign users to groups and access rights to groups. You can assign system administration privileges to users for lightening the administrative workload.

Though all the other products here can assign IP addresses automatically, TeamWare makes you enter the IP address of the TeamWare server manually on each client PC—a task that gets old quickly.



You can control access to your TeamWare calendar file by creating a separate permission profile for each user. TeamWare's excellent Admin console provides real-time monitoring and detailed logging of TeamWare services.

GO, TEAM, GO

As in the other groupware products, messaging is at the heart of TeamWare. TeamWare Mail presents a tree view of your mail, organized by in and out folders. You can create additional, nested folders to help organize archived messages in a meaningful way, then drag and drop messages between any of them. TeamWare Mail lets you grant other users or groups full or partial access to mailboxes.

When you right-click on any message in the tree view, TeamWare presents a menu of actions you can perform, such as reply, forward, and delete. But additional controls distinguish it favorably from the other groupware packages. You can post a message to a discussion forum, save the message into the file library, or create a calendar appointment from the message. A unique option lets you mark the message as interesting by displaying a green check mark alongside the header. Curiously, TeamWare is the only package that lacks an SMTP server for outgoing Internet mail. The installer disk contains a 30-day trial version of MetaInfo's Sendmail SMTP server, but you must purchase the MetaInfo server separately ($600 list) for use after the trial period.

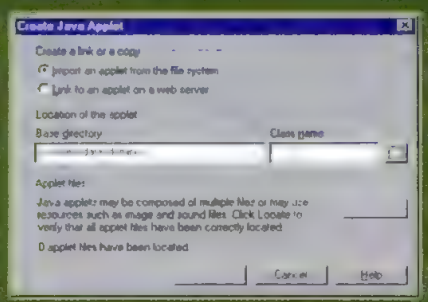
TeamWare's calendar program is simply the best we've seen. The unit makes it easy for users to share calendars, so you can check a colleague's availability for a meeting. You decide how much calendar detail other users can view, and you can even grant someone else permission to make changes to your schedule.

When you schedule a meeting, alert the parties involved and they can either accept or reject the date and time—making it easy to arrange staff meetings or lunch outings. A nice touch is TeamWare's ability to color-code your calendar automatically, assigning different colors for appointments that are confirmed, private, rejected, conflicting, or unanswered.

The unit provides a threaded-discussion application (TeamWare Forum) and a file distribution and document management program (Library). Both operate very much like the TeamWare Mail program. Discussion messages are displayed in a tree view, with a separate tree for each topic.

Building on a Groupware Platform

Groupware isn't one-size-fits-all. Larger organizations with development staffs will probably prefer the more customizable Lotus Domino, Microsoft Exchange, and Netscape SuiteSpot, while Fujitsu TeamWare and Novell GroupWise will better meet the needs of smaller organizations, which will want a good fit right out of the box.



Lotus Notes Designer includes Java development capability.

Lotus development centers on Notes Designer ($495 list), a Notes client that also includes an integrated development package. Notes Designer features Lotus's Integrated Development Environment (IDE), which has object-oriented forms for graphically laying out your custom document interface. You have the option of using several different scripting tools to add automation and workflow. Notes @functions and @commands (the Notes Formula Language) let you perform simple tasks such as field validation and form automation in basic applications.

For more complex tasks, Notes Designer includes LotusScript, a BASIC-like programming language. Notes also includes tools for building fields to include special views in Web applications and a tool for linking Java applets to applications. If you're interested in doing JavaBean development, Lotus includes its own Lotus BeanMachine, a tool to tie Bean components together into an applet. In addition, Designer's tight integration with IBM's NetObjects Fusion lets you easily import NetObjects Web applications to run on Domino.

Microsoft Exchange provides a mixed bag of options for developing groupware applications. At the lower end, Microsoft includes the Outlook Forms tool, which lets you graphically create, customize, and automate message forms. For more sophisticated applications, Microsoft lets you use VBScript or Jscript. These streamlined scripting languages let you combine Exchange elements to produce workflow and other applications.

For Web development, Microsoft uses ASP (Active Server Pages) architecture to assemble combinations of Jscript, HTML, JavaScript, and occasionally ActiveX into a single application. To develop ASP, Exchange comes with Microsoft's Visual Interdev, which includes a series of ActiveX components usable by other applications. Besides components for providing interface equivalents for Web users, you can also use ActiveX components to connect with back-end applications such as Microsoft's SQL Server.

Netscape SuiteSpot is a standards-based product that gives you the flexibility to use any third-party tool that develops to those standards. Netscape does offer a product called Netscape Visual JavaScript. Visual JavaScript is a scripting language that combines a series of JavaBeans to perform specific services such as perform a lookup in Netscape Directory Server.

Novell GroupWise and Fujitsu TeamWare take a different approach. Both appeal to organizations that want turnkey groupware functionality, although they provide client APIs, DLLs, and OCXs for accessing their servers to allow some integration with existing programs.—*TP*

Users can reply to messages directly in the forum or privately via mail. Like e-mail messages, discussions include rich-text formatting and embedded attachments.

The Library program includes excellent document version control and library check-in/check-out features. Though its document management is on a par with that of GroupWise, TeamWare's Library interface isn't as slick.

LEFT OFF THE ROAD TEAM?

A major consideration in choosing a package is whether you need off-line access. Though TeamWare lets you dial in to the server directly, the client won't function without a live connection. If your organization is rife with road warriors, you can't afford to go without off-line access.

Nevertheless, TeamWare provides several ways for users to access their messages over the Internet. The bundled mail servers let you check mail using any standard mail client, and the Web Access module offers access via a browser to TeamWare Mail, Forum, and Library. But unlike all the other groupware products, TeamWare does not support SSL.

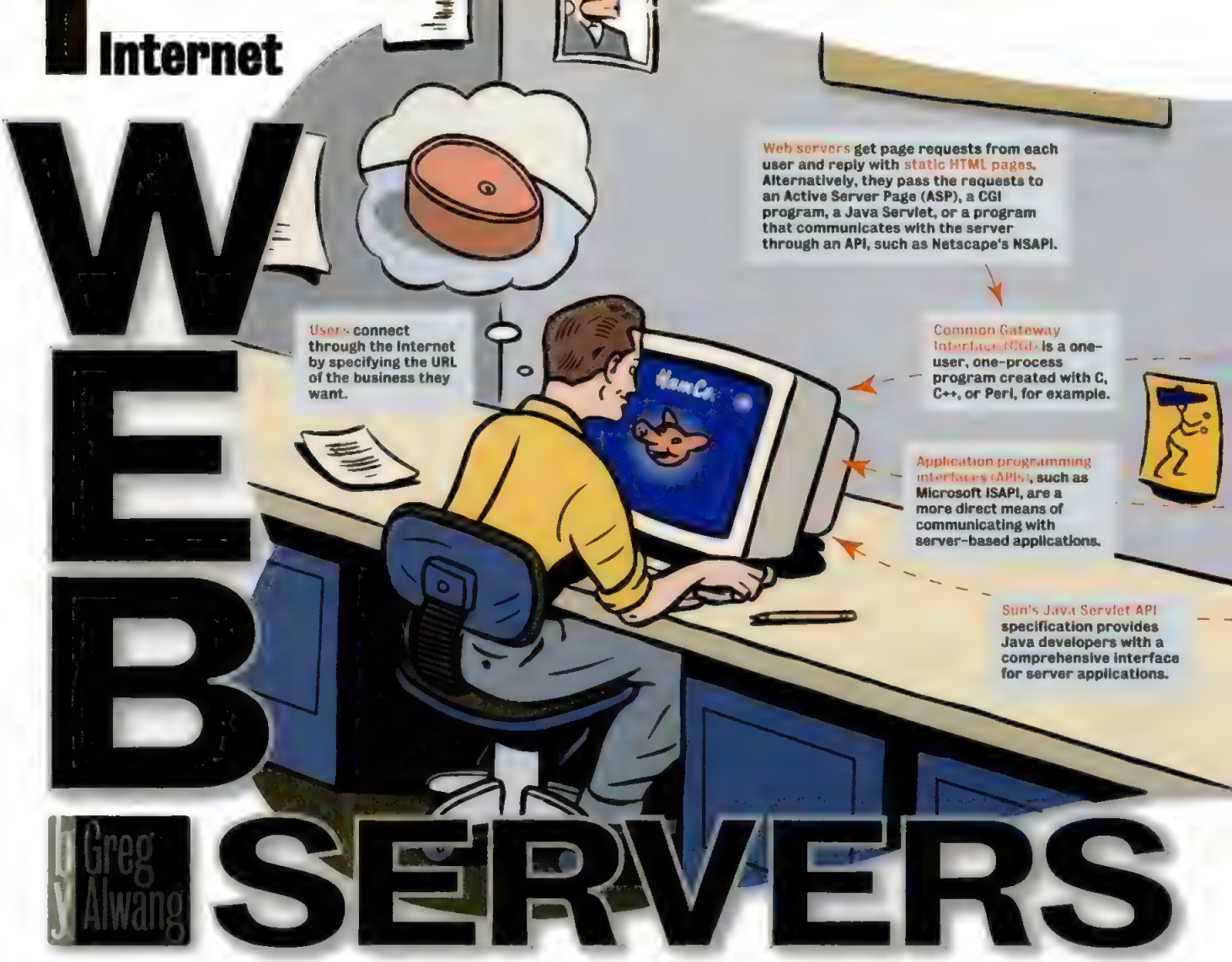
The Web Access module requires that you install either Microsoft Internet Information Server 3.0 or Netscape FastTrack. As with GroupWise, TeamWare's Web server doesn't let you send attached files from Internet Explorer 3.0, and we received some incomprehensible error messages when trying to move messages.

The package includes TeamWare Embla 2.0, an excellent IMAP-capable mail client that closely resembles the proprietary TeamWare mail program. We found Embla to be flexible and easy to use, but unlike Outlook, it can be configured to work with only one mail system. —*LF*

TeamWare Office 5.1. List price: 5 users, $1,495. Requires: For Windows NT server: Pentium/133-based PC or better, 64MB RAM, 20 MB hard disk space; for Sun Solaris server: 64MB RAM; for Windows 3.*x* client: 16MB RAM, 20MB hard disk space; for Windows 95 or NT workstation: 16MB RAM, 10MB hard disk space. Fujitsu Software Corp., San Jose, CA; 888-248-9273; www.fsc.fujitsu.com. *Choose 515 at www.pcmag.com/infolink.* PC

WEB SERVERS

by Greg Alwang



WHETHER YOU NEED POWER FOR RUNNING A HIGH-TRAFFIC WEB SITE OR EASE OF USE IS YOUR MOST IMPORTANT ISSUE, THE LATEST WEB SERVER SOFTWARE CAN BE TAILORED TO YOUR NEEDS.

As the Web and the software engines that run it—Web servers—evolve, this platform is becoming much more than a virtual host to your electronic brochures. You can run your business on it. HR applications, order entry and management tied into your legacy database, and electronic storefronts are just a few examples of the types of applications you can run from your Web server today. No longer limited to serving static HTML content, today's Web servers are primed for handling high-traffic requests and providing a platform for critical business functions.

In this roundup, we review nine Web servers running under four major operating systems on three hardware platforms, in an effort to help you decide on the best combination for running what is becoming the centerpiece of most companies' new systems development. Unless you're starting from scratch, the investment your company has already made in infrastructure and human capital will largely influence your decision.

More Online

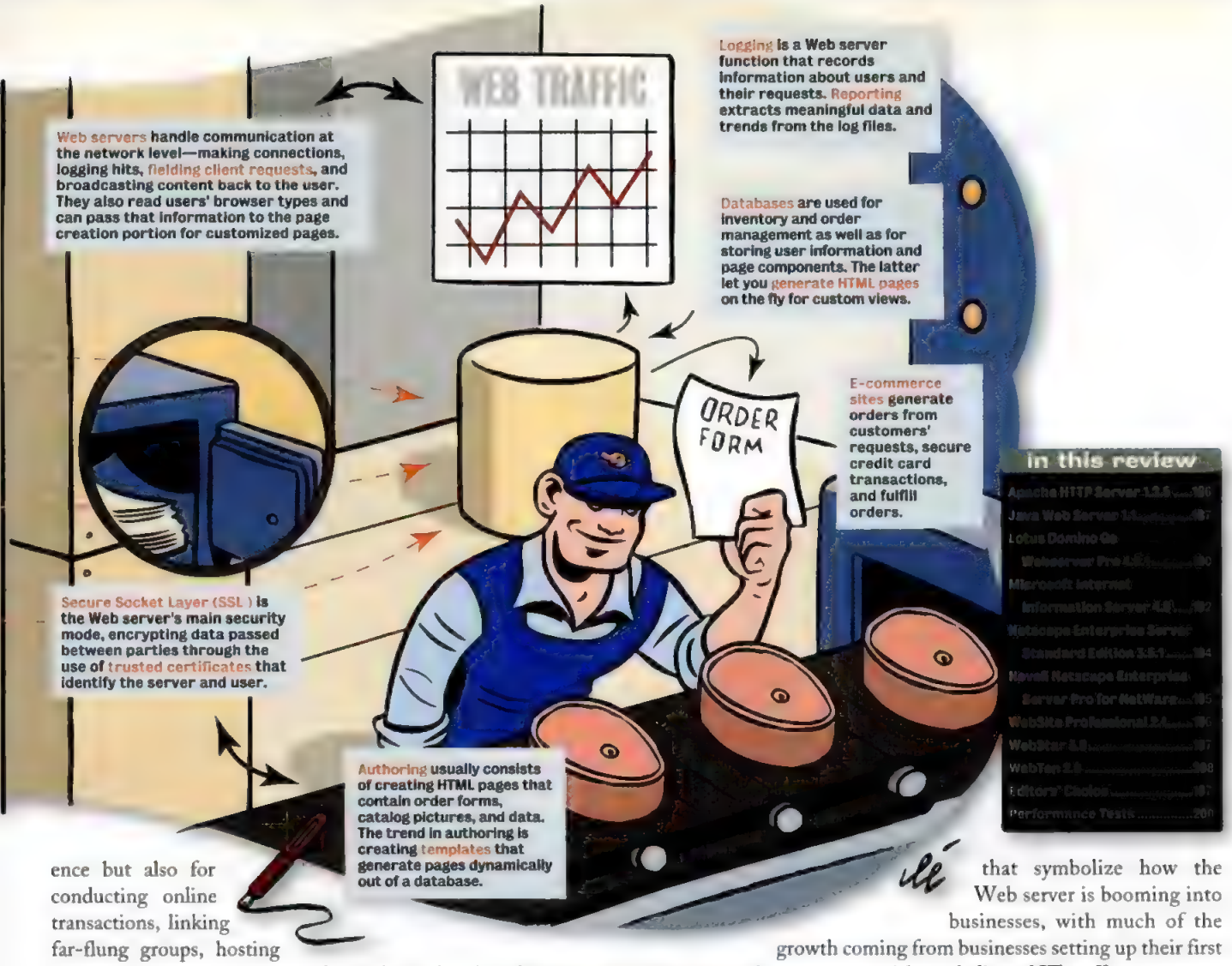
Visit www.pcmag.com to see how a Web server works, what its elements are, and how those elements interact.

The Web server landscape is made up of two distinct markets: public Web sites and intranets. Both are growing at astronomical rates. Apache HTTP Server, the freeware Unix stalwart (now available for *x*86-based hardware), continues to rule the Internet—commanding almost 50 percent of public Web sites, in large part thanks to Unix's historical stability and scalability. But Microsoft Internet Information Server (IIS) is making significant inroads, having doubled its market share to more than 20 percent in the last year. Netscape's market share has slipped, from 14 percent of the public Web market in 1997 to 10 percent today, but that only means that Netscape's business is not growing at as fast a rate as Microsoft's.

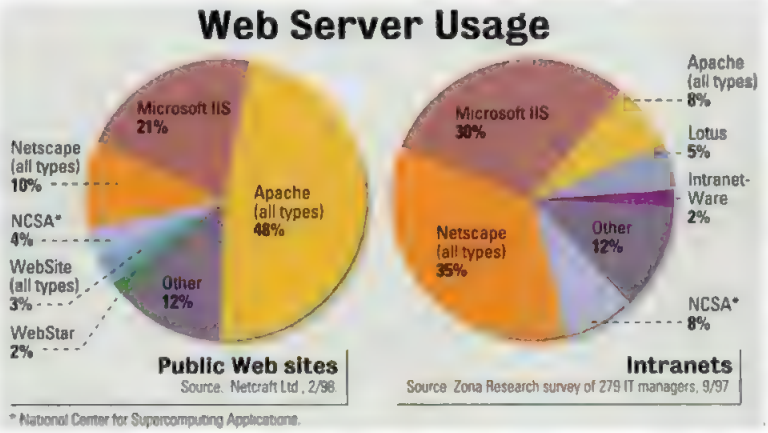
On the intranet side, on the other hand, Apache commands barely 8 percent of the market, while major players Microsoft and Netscape dominate with a combined two-thirds of the ever-increasing pie. Microsoft has taken advantage of integrating IIS tightly into Windows NT 4.0 to capture more of the intranet market as it sells more copies of Windows NT Server. Netscape has not lost focus in its target on the enterprise market, and the rich set of features that constitute its Netscape Enterprise Server show the fruits of that focus.

With the Internet taking on such a pivotal role in today's business, Web servers have become essential not only for building a Web pres-

ILLUSTRATIONS BY MARK MATCHO



ence but also for conducting online transactions, linking far-flung groups, hosting enterprise-scale applications, and providing a distributed communications infrastructure. Web servers enable this new reality by including APIs or server-side scripting language support to build dynamic Web applications. Although everyone offers the Common Gateway Interface (CGI) for such tasks, Microsoft, Netscape, O'Reilly, and Sun deliver the most flexibility for development options. And such CGI alternatives as NSAPI and ISAPI clearly improve server performance compared with CGI, based on our WebBench test results. Many of the Web servers also include a developer's license for a SQL database, and Novell Netscape Enterprise Server Pro for NetWare even includes a five-user license for Oracle 7.3.



The latest generation of Web servers also represents the most significant democratization of the technology yet. You no longer need a degree in Unix programming to set up and maintain a Web server. *Usability, flexibility,* and *performance* are the new buzzwords that symbolize how the Web server is booming into businesses, with much of the growth coming from businesses setting up their first intranets—in many cases without dedicated IT staffs.

With intuitive products such as Microsoft IIS, Netscape, and WebSite Professional, Web server neophytes can create basic sites and set up and manage servers. Even Apache—which, compared with WebSite, is still very challenging—has made inroads in ease of use thanks to the new Red Hat Linux GUI.

The underlying technology has also improved since our previous Web server roundup a year ago. The HTTP 1.1 specification has taken shape and helps improve server performance and flexibility with features such as connection persistence, caching, and the ability to bind multiple domain names to a single IP address using host headers. This last feature lets ISPs conserve IP addresses by supporting more domains on fewer IP addresses.

Each of the Web servers we review has something unique to offer users on their respective operating systems.

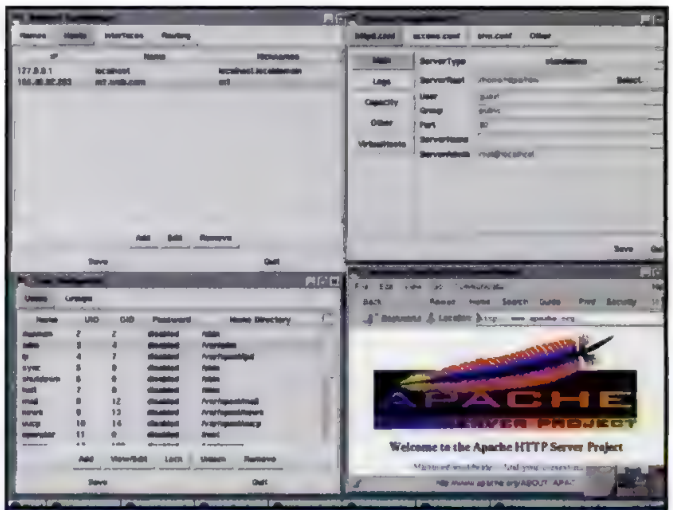
The Apache Group

Apache HTTP Server

For sheer number of public Web sites, Apache HTTP Server 1.2.5—a freeware Web server maintained by the Unix community—is still today's undisputed market champ. Although it is not well suited for Unix newcomers (it requires more manual tweaking than any other server), Apache dominates the Web, because of its low cost, excellent performance, and great flexibility. Poor ease of use and content management tools, though, should steer you toward Microsoft Internet Information Server 4.0, Netscape Enterprise Server Standard Edition 3.5.1, or WebSite Professional 2.1 for intranet development, especially if you don't have dedicated IS support.

We tested Apache's features on Red Hat Linux 5.0 using Intel *x86*–based hardware, because Red Hat's support and installation made the product more comparable with the Windows NT–based Web servers in this roundup. We also tested Apache's performance on Solaris, one of the more popular platforms for Apache.

Apache was an excellent performer on our CGI tests, particularly on Solaris. No server outperformed Apache under Solaris; Apache on Linux held steady with Microsoft IIS on Windows NT as client load increased, and it showed better scalability. On our static tests, Apache was an average performer, doing not nearly as well as Microsoft IIS and Netscape Enterprise on Windows NT, and Lotus Domino Go Webserver Pro 4.6.1 and Netscape Enterprise both outshone Apache on Solaris.



With Apache, you can use the "configurator" utilities to manage users, groups, IP addresses, and virtual hosts.

Like Microsoft IIS under Windows NT, Red Hat Apache is intertwined with Red Hat Linux, so when you install your operating system, you can also install Apache. Customizing Apache for such advanced features as virtual hosting and passwords is a little trickier, however.

Don't expect access to all administration functions with rich graphical interfaces as in Netscape Enterprise and WebSite. Red Hat's version of Linux does include several "configurator" utilities, but we found these utilities a bit limited for Windows-oriented Webmasters. Set-

suitability

POWER	Apache HTTP Server 1.2.5	Java Web Server 1.1	Lotus Domino Go Webserver Pro 4.6.1	Microsoft Internet Information Server 4.0	Netscape Enterprise Server Standard Edition 3.5.1	Novell Netscape Enterprise Server Pro for NetWare	WebSite Professional 2.1	WebStar 3.0	WebTen 2.0
Documentation	Fair	Good	Good	Excellent	Excellent	Good	Excellent	Good	Good
Installation and configuration	Fair	Good	Good	Excellent	Excellent	Good	Excellent	Good	Good
Server management and administration	Good	Good	Good	Excellent	Excellent	Good	Excellent	Fair	Good
Content and site management	Fair	Fair	Good	Good	Excellent	Excellent	Good	Fair	Poor
Web development	Good	Excellent	Good	Excellent	Excellent	Excellent	Good	Poor	Fair
EASE									
Documentation	Poor	Fair	Good	Good	Excellent	Fair	Excellent	Good	Good
Installation and configuration	Fair	Poor	Poor	Good	Excellent	Fair	Good	Good	Good
Server management and administration	Fair	Good	Fair	Good	Good	Good	Excellent	Fair	Fair
Content and site management	Fair	Good	Excellent	Excellent	Good	Good	Excellent	Good	Poor
Web development	Good	Good	Fair	Excellent	Good	Good	Good	Good	Good

Documentation We look for clear, easy-to-follow manuals with useful indexes. Thoroughness and examples ensure a high rating for *power*. Products with documentation both in HTML online and in printed, bound formats receive high ratings. Having both is a plus.

Installation and configuration The setup program should run correctly, and we look for products with thorough installation scripts or wizards. We assume users will have a reasonable knowledge of TCP/IP configuration and Web servers, but we still expect an intuitive setup routine. The server should run after installation without any further manual fine tuning, especially for first-time users. The ability to tweak the server afterwards adds to the *power* rating. Wizards that analyze the machine and make intelligent default choices add to the *ease* rating. Installations that integrate with the OS are considered a plus on the *power* side.

Server management and administration The availability of a dedicated on-console management application is a necessity. Browser-based administration is important for remote management. Administrator access should be more secure than just a dedicated port on TCP/IP. Full remote control, such as starting and stopping the Web server, is a plus. Setting up users and groups should be easy. Being able to import the users and groups set from the OS improves a product's rating, as does the ability to update the OS user and group settings from the server.

Content and site management We evaluate the tools to create, publish, and manage content on your Web site. A better program includes an HTML authoring tool, an imagemap utility, an FTP server, a site-mapping tool, and a link checker. Users should be able to redirect URLs easily, including redirecting them to another server. Publishing tools are also a plus. In addition, we look for end-user upload (HTTP put) capabilities, user home directories, integrated search engines, version control systems, and content conversion tools.

Web development We examine to what level a Web server can function as a development platform. We assume CGI support and look for broad support for various APIs, such as ISAPI, NSAPI, and WSAPI. Support for some form of server-side scripting, such as JavaScript, is a plus. Additional Web development options, such as Active Server Pages or servlets, are bonuses. Any tools, content samples, templates, canned CGI scripts, or ISAPI/NSAPI examples, as well as documentation, significantly improve a product's *ease* rating.

ting up permissions for individual users means coordinating between Unix users and groups and Apache or creating your own users and groups.

For basic tasks of Web administration, the configurator utilities get you only so far. We had to edit the configuration (CNF or equivalent) files manually using a text editor. This approach to configuration is powerful, because the Apache configuration file supports almost 100 different tags (used just like HTML tags) for managing all aspects of Web administration and performance. But this is also where the inexperienced Linux/Apache user will be most likely to get lost.

Online documentation is hit-or-miss. You don't have a comprehensive hypertext help system, as with Netscape Enterprise. Instead, help in Apache consists of searching individual help files and *man*, or manual pages, a standard Unix convention.

Freeware Apache is missing a number of features that we have come to expect in a Web server. Remote browser-based administration is still not available, although you can telnet in and handle any administration tasks. Red Hat's Apache by itself also lacks SSL-level security, but you can license it yourself from RSA Corp. A secure version of Apache called Stronghold is available from C2Net Europe.

Apache does not offer reporting and searching tools, and aside from the version of Netscape Communicator 4 for Linux included here, it has very little to offer in the way of content management. For testing, we downloaded a free reporting tool, ht://Dig, which worked fine for basic reporting and searching.

We couldn't check or fix broken links using what was shipped in the product, although you can download programs for this task. Aside from using Grep (a utility that searches for keywords) and editing HTML files manually, we couldn't change links in HTML documents to new locations.

The principal strength that makes Linux an excellent development platform is its low-level access for developers and Web administrators. The product's performance running dynamic Web sites bears that out. On the Red Hat version, developers get full support for CGI, Perl, TCL, a built-in C or C++ compiler, and an Apache server API on a par with ISAPI and NSAPI for developing server-side components. A SQL database, PostgreSQL 6.2.1, which features database management and a visual query builder, is also included and had no problem handling a data-driven sample Web site for our testing script.

With its combination of low price, good configurability, and fine performance, Apache is likely to be a good choice for those who have at least some Unix experience.—*Richard V. Dragan*

Apache HTTP Server 1.2.5. List price: Free. The Apache Group; www.apache.org. *Choose 553 at www.pcmag.com/infolink.*

List price: With Red Hat Linux 5.0 for *x86*, $49.95. Red Hat Software Inc., Research Triangle Park, NC; 888-733-4281, 919-547-0012; www.redhat.com. *Choose 554 at www.pcmag.com/infolink.*

Sun Microsystems Inc.

Java Web Server

A highly extensible Web server written in Java, Sun Microsystems' Java Web Server 1.1 will certainly appeal to you if you're investing in Java as a Web platform. Its administrative tools have some rough edges, paling when compared with those of Microsoft Internet Information Server 4.0, Netscape Enterprise Server Standard

editors'

Netscape Enterprise Server Standard Edition 3.5.1

Depending on your infrastructure investment, in-house expertise, and content platform, any of the nine Web servers in this roundup may work for you. But Netscape Enterprise Server Standard Edition 3.5.1 provides the best mix of features, usability, and performance for the broadest array of Webmasters, and so we award it our Editors' Choice.

Netscape Enterprise presents an excellent platform upon which Webmasters can create the kind of dynamic, interactive Web applications that you need for your business today. Its tools are varied and generally superb, and it's the only server that lets you decentralize your content management, an approach that is more realistic as intranets and extranets grow. Netscape Enterprise also performed strongly on both Microsoft Windows NT and Sun Solaris, so it gives you cross-platform flexibility.

For specific needs, different servers provide capable solutions, and so we give two products honorable mentions. If you are running Microsoft BackOffice and have a commitment to Windows NT 4.0, Microsoft Internet Information Server 4.0—free with a Windows NT license—is a good choice, because it will integrate with your existing infrastructure.

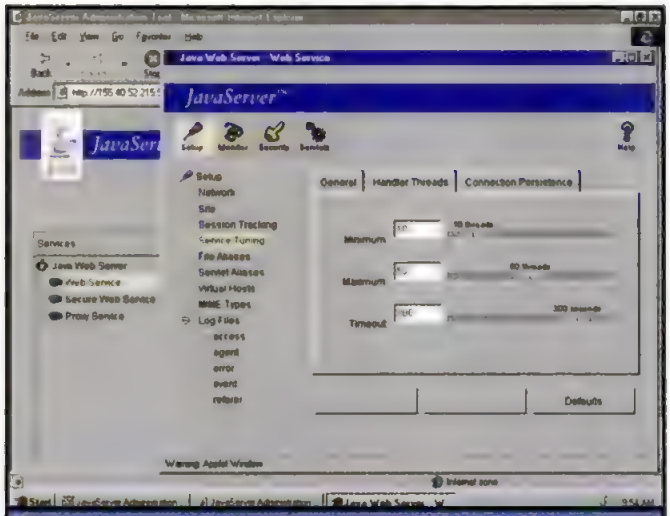
O'Reilly & Associates' WebSite Professional 2.1 has one of the best management consoles in the roundup. No Web server is better suited to the part-time Webmaster who was thrust into the job without much prior IT experience. WebSite's relative performance and lack of a browser-based management option keep it from being an all-purpose solution such as Netscape Enterprise.

Our Contributors: GREG ALWANG and STEVE RIGNEY are contributing editors of *PC Magazine*. RICHARD V. DRAGAN is a programmer and Ben Gottesman is a technical director at PC Magazine Labs. CHRIS LEMMONS is a development leader at Ziff-Davis Benchmark Operation (ZDBOp). JOHN GARRIS is a Leader at Scient, a professional services firm specializing in advanced network technology solutions, and a frequent contributor to *PC Magazine*. J.W. DAVIS is a freelance writer. BRAD WALDEN is a support technician at PC Magazine Labs. JAY MUNRO was the project leader, and DAVID LIDSKY was the associate editor in charge of this story.

Edition 3.5.1, and WebSite Professional 2.1, but Java Web Server offers the best platform for deploying server-side Java.

Java Web Server is based on the new Java Servlet API model and consists almost entirely of servlets. *Servlets* can provide Web functions such as serving pages, maintaining sessions, and analyzing logs.

The crux of Java Web Server is that anything you can do in Java you can plug into Java Web Server as a servlet. Thus you can take advantage of Java and all its related features—such as JDBC database connections and JavaBeans—to extend and create dynamic applications around the Web server. This makes the software an ideal platform for Java developers looking to distribute customized Web applications. Sun claims that Java Web Server runs on any JDK 1.1 platform, though we tested its features on Windows NT 4.0 and performance-tested it on Windows NT and Sun Solaris or SPARC, the only two operating systems that support Java Web Server.



Java Web Server's elegant browser interface utilizes tabbed pages and expandable lists.

As an application platform, Java Web Server makes deploying Java applications easy. A feature called Page Compilation lets you embed Java code directly into your HTML pages, and the product handles the rest. Page Compilation performs a function similar to that of Microsoft's Active Server Pages (ASP) scripting, but Page Compilation is not scripting. Rather, it's actual Java code that gets compiled into servlets on the fly. You can code in Java without writing setup code, reference classes, or compiling; Java Web Server handles all these functions. Like Microsoft's ASP, this delivers immense flexibility to developers creating dynamic Web applications.

Java Web Server eases the burden of site design with servlet-based presentation templates, which let you specify the look and feel of a site in template files. The server combines these templates with the content pages on the fly, so you can change the look of an entire site simply by modifying one of these templates.

Java Web Server's performance numbers were near the bottom of the pack on our static HTML tests, with performance under Windows NT exceeding output on Solaris. This bucks the trend of products such as Netscape Enterprise and Lotus Domino Go Webserver Pro 4.6.1, whose Solaris versions outperformed their Windows NT versions. Because the WebBench 2.0 benchmark test program doesn't yet support servlets, we were not able to do API or in-process performance tests. Java Web Server's CGI test results were abysmal, particularly on Windows NT, but you're not very likely to use CGI if you use Java Web Server.

Administrative access to Java Web Server is through a Web browser or applet viewer. The administrative applet has a Java-only interface, with push buttons, expandable lists, and tabbed pages that make it resemble a standard Windows application, even on Solaris.

You control most site characteristics from the administration applet, but some options, such as multihosting and certificate creation, require a command line utility. Most server changes are updated dynamically, but as with most other servers, some changes (such as establishing SSL encryption) require a full server restart.

To set up multihosting, you use the command line utility Addservice, which advises you to "use with caution" when you start it. And as we found out, this is not an idle threat. The process was much more difficult than it was on other Windows NT–based Web servers, such as Go Webserver and WebSite .

Java Web Server gives you a choice of setting up multiple hosts on either separate IP addresses or a shared address. Under Windows NT, the operating system lets you bind multiple IP addresses to one network card, though Java Web Server doesn't support them very well. If both hosts run on the same port, Java Web Server refuses to start. You can, however, run multiple IPs bound to a single card if you listen on different ports, such as port 80 and 81. We did not run into this same port limitation on the other Windows NT–based Web servers.

Virtual-directory mappings are easy to set up, but you cannot browse for directories, so you must manually type in each one. Java Web Server also supports servlet aliasing, in which a URL can be mapped directly to a servlet.

Realms are used to track user and group data, which can be entered manually or read directly from Windows NT's User Domain. When you create your own groups, you must enter them one at a time rather than selecting multiple users at once.

If you have a significant Java development investment, Sun's Java Web Server, with its servlet-centric architecture, may be your best choice.—*Greg Alwang*

Java Web Server 1.1. List price: $295. Sun Microsystems Inc., Palo Alto, CA; 888-843-5282, 512-434-1591; java.sun.com. *Choose 555 at www.pcmag.com/infolink.*

Lotus Development Corp.

Lotus Domino Go Webserver Pro

With the ability to run on almost any platform, a built-in caching proxy server, PICS support, and powerful security and searching capabilities, Lotus Domino Go Webserver Pro 4.6.1 offers some noteworthy features. But for all of the product's power, it lacks the polish of more sophisticated tools such as Microsoft Internet Information Server 4.0 and Netscape Enterprise Server Standard Edition 3.5.1. Go Webserver's interface, setup, and configuration options need improvement.

Go Webserver, the HTTP portion of the Domino application server, is based on IBM's Internet Connection Secure Server ("Beyond Unix," May 27, 1997) and is the engine IBM uses for its high-profile, high-traffic Web sites for events

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such as chess matches and the Olympics. (We review Domino in "The Server Side of E-Mail" in this issue.)

To help you create and run your own Web applications, Go Webserver includes both CGI and WinCGI scripting capabilities. The product does not work with server-side Java and JavaScript, though, as Netscape Enterprise does. Lotus Development Corp. provides its own Notes API and IBM's ICAPI for in-process needs, such as those you find with Microsoft's ISAPI and Netscape's NSAPI. And if you buy Go Webserver Pro ($595 list) instead of the standard package ($495 list), you get the excellent NetObjects Fusion for Web site creation and Lotus BeanMachine for creating Java applets for your Web site.

One of Go Webserver's great strengths is support for a wide variety of platforms. Although we installed and tested Go Webserver on servers running Windows NT 4.0 and Solaris, you can also install Go Webserver on AIX, HP-UX, OS/2, OS/390, and Windows 95.

Go Webserver delivered strong results in all our performance tests, but getting them took a lot of effort. To maximize performance, we decided to load documents into the server cache. When we started the Web server, it read the configuration file and added all the listed files to its cache manually. For WebBench 2.0's workload, we had to add 6,010 lines manually, one for each unique file. This was unacceptably arduous; users of Go Webserver will likely not use the cache and accept lesser performances. Go Webserver handled our CGI tests well, particularly under Solaris.

Go Webserver functions only as a server for HTTP, but its built-in proxy server can cache HTTP as well as NNTP and FTP requests. The proxy server provides faster access and cuts down on the network traffic across your Internet connection by saving HTML pages and other files you retrieve from the Web and putting them on your server's hard disk.

Installation and server management are two areas where Go Webserver's lack of polish gets in the way. The software isn't as easy to use as Netscape Enterprise, Microsoft IIS, or WebSite Professional 2.1. Go Webserver proved fairly easy to install, but progress tracking was confusing.

For server management, you can use the Web-based management utility or edit the configuration files manually. We found that using the Web client was definitely easier, but we encountered lapses in consistency as we navigated configuration screens, which left us unsure as to when we had completed required tasks.

You may want to turn off the logging features to provide the best server performance. But enabling them will probably provide you with probably more information than you'll ever need. We were able to keep detailed log information on user access, errors, CGI errors, agents, and references. You can save these logs, roll them over every 24 hours, and even create detailed graphics with them.

The trace feature takes Go Webserver's information-gathering capability one step further. You get excellent data on the number of connections, the amount of traffic, and even the types of network protocols that are traveling across the network.

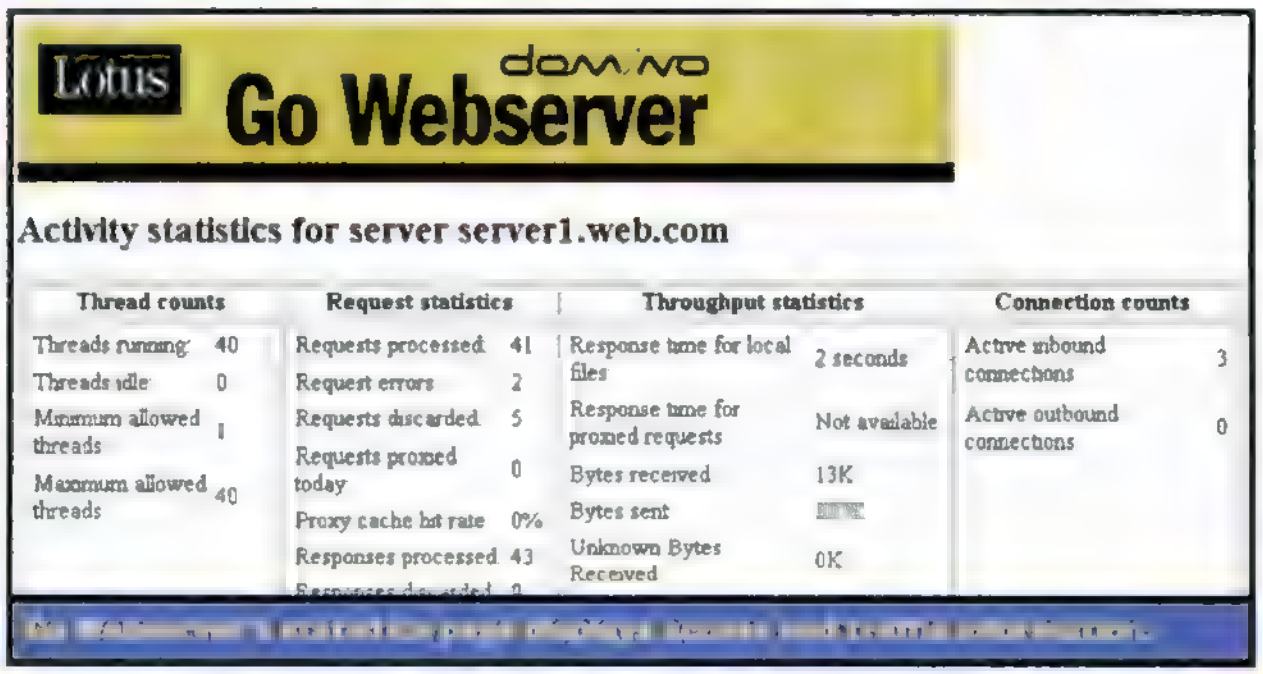
NetQuestion is a powerful search engine that lets you find specific data in a group of documents. You can search on keywords or use Boolean logic or wildcards to find phrases or documents.

Like most of the other products in this roundup, Go Webserver provides security via user names, passwords, and SSL 3.0. Go Webserver provides a key-pair generator for third-party SSL certificate requests. For use on an intranet, the product includes its own Certificate Authority.

Go Webserver, like Microsoft IIS, includes a Platform for Internet Content Selection (PICS) server that lets you rate your Web content. This server answers the need Webmasters have to inform users of the content of internal pages of sites, especially public Internet sites.

The addition of Fusion, BeanMachine, and the proxy server make Go Webserver a full-featured Web server for most users' needs. But we would like to see an improved management interface to make life a little easier when you set up users and URL locations.—*Steve Rigney*

Lotus Domino Go Webserver Pro 4.6.1. List price: $595. Lotus Development Corp., Cambridge, MA; 800-343-5414, 617-577-8500; www.lotus.com. *Choose 556 at www.pcmag.com/infolink.*



Microsoft Corp.

Microsoft Internet Information Server

With a comprehensive feature set, an excellent new management interface, and improved ease of use, Microsoft Internet Information Server 4.0 demystifies the task of building and managing your own Web server on Windows NT. Microsoft IIS also has the best performance in this roundup, making it suitable for medium-size to large sites doing high-volume serving or corporate Web developers looking for ease of use. Only Netscape Enterprise Server Standard Edition 3.5.1 offers a more complete solution, with its power to make all users publishers and managers out of the box, thereby decentralizing Web management. If you have a significant investment in Microsoft BackOffice and COM development, Microsoft IIS will be your natural choice because of its strong integration with your existing infrastructure, and it's included with your Windows NT license.

Some of the strongest content and site management tools bundled with any Web server make creating and managing your intranet or Web site easier. Microsoft IIS comes as part of the Windows NT Option Pack. The pack also includes Microsoft FrontPage 98 (a *PC Magazine* Editors Choice in "Web Authoring Tools," January 20, 1998), which gives you a full-featured editor and wizards with which to

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build a site.

If you already have a site, you can import and catalog existing Web sites and use FrontPage to manage your site—finding broken links, updating moved links, and converting Windows image formats such as BMP to Web-friendly GIF and JPEG files automatically. FrontPage is a separate product, though, and is therefore not as well integrated with the Web server as are Netscape Enterprise's tools.

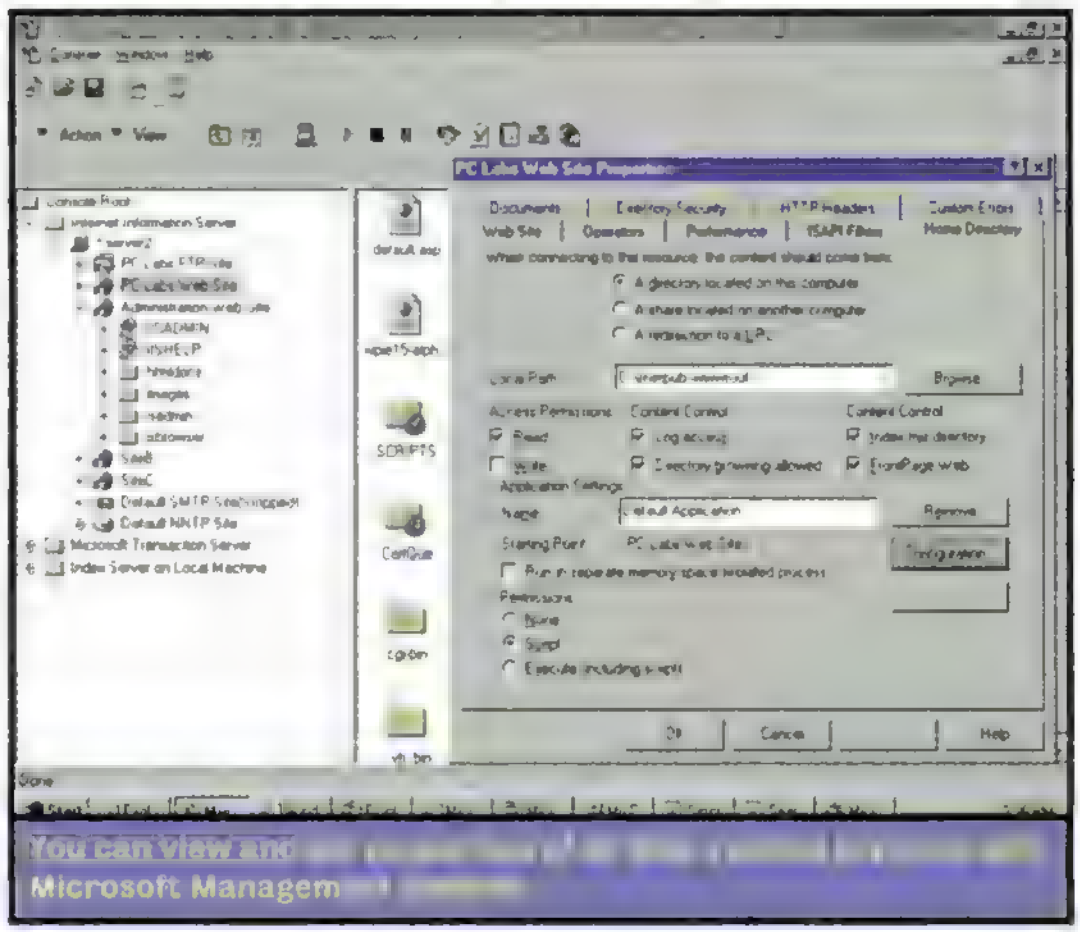
For more sophisticated site development, the Windows NT Option Pack that includes Microsoft IIS also includes other Microsoft servers such as Microsoft Certificate Server, Index Server, Message Queue Server, and Transaction Server (MTS), giving you most of the tools you need to create dynamic, secure Web sites.

Active Server Pages (ASP) are scripts that execute on the server and generate Web pages to send to the client. Using ASP, developers can create applications that are inherently transactional, because MTS runs while ASP is running. This means developers no longer have to include complex transaction code in their programs manually. Rather, Microsoft IIS and MTS handle the completion or failure of the transaction in the background.

ASP applications run in the same process as the Web server itself. Microsoft also provides its Internet Services API (ISAPI), an API for creating native programs that also run in process. By calling COM objects from either ASP or ISAPI programs and passing them to MTS, you can run them in a separate process with no threat to the stability of the server.

Regardless of whether you choose CGI, ISAPI, or static HTML to create your Web applications, Microsoft IIS leads all others in this roundup in Web server performance. It had the best performance on our in-process and static HTML tests in WebBench 2.0 and handled our CGI mix very well.

The new Microsoft Management Console (MMC) follows WebSite Professional's lead with central management of any server on your network, but MMC takes advantage of Windows NT integration to do more than WebSite and other servers can. MMC lets you manage additional Windows NT services, such as MTS, just by snapping them into the interface. You can also access Web, FTP, SMTP, and NNTP services from MMC.



Microsoft IIS, unlike WebSite, also provides remote browser-based administration, which closely resembles the MMC interface although it does lack some usability features, such as tabbed property pages. It is still a good alternative for remote administration and a step up from the sometimes clunky browser interfaces in both Lotus Domino Go Webserver Pro 4.6.1 and Netscape Enterprise.

Along with simplified administration, Microsoft IIS offers superb flexibility for creating virtual directories and multihosting. If you're new to these Web server concepts, a wizard steps you through the process. With Version 4.0 you can easily redirect users to URLs on other servers using the Home Directory properties.

Multihosting support is one of Microsoft IIS's strongest features. Windows NT lets you bind additional IP addresses to a single network card, so each virtual server can have its own IP address. Other Windows NT–based servers can take advantage of this feature, but Java Web Server on Windows NT had more difficulty, because of a problem with the default port settings.

Security is tightly integrated with Windows NT's User Domain, meaning that you get all the benefits of Windows NT's security implementation, from basic access control to challenge/response authentication to SSL 3.0 encryption. WebSite is more flexible and more powerful, letting you use Windows NT users and its own users for a true two-tiered security scheme.

Site Server Express capably handles your reporting functions; it includes more than 25 canned detail and summary reports covering everything from hit and browser summaries to site trends.

With companion tools that offer greater scalability and flexibility, Microsoft IIS includes everything a corporate Web developer running Windows NT needs in a Web server.—*GA*

Microsoft Internet Information Server 4.0. List price: Free with Microsoft Windows NT 4.0 or Windows NT 4.0 Option Pack (Windows NT 4.0 with 5-user license, $809; with 100-user license, $3,754). Microsoft Corp., Redmond, WA; 800-426-9400, 425-882-8080; www.microsoft.com/iis. *Choose 557 at www.pcmag.com/infolink.*

Netscape Communications Corp.

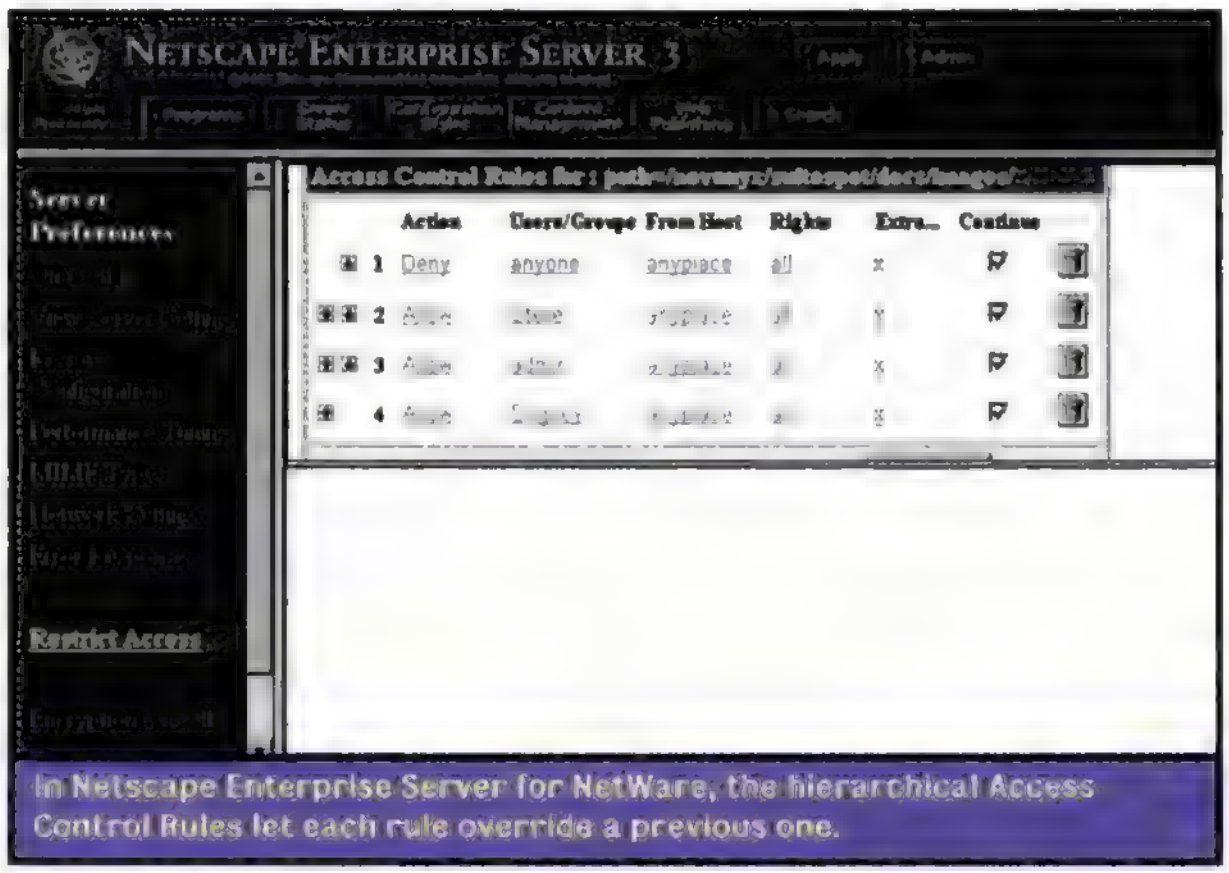
Netscape Enterprise Server Standard Edition

For those developing sophisticated or large-scale Web sites, Netscape Enterprise Server Standard Edition 3.5.1 is a great choice, because of its unparalleled feature set. With a wide variety of options for using your server as an application platform—Java in particular—Netscape Enterprise makes Web development easy. Its excellent content management features can put managing and publishing power in the hands of your users, an unrivaled and forward-thinking feature. If your shop is already based on the Windows NT versions of Microsoft's BackOffice family of products, Microsoft Internet Information Server 4.0 may be a better solution. Still, Netscape Enterprise combines innovative features and performance that should meet most users' needs.

Netscape Enterprise is much improved over Version 2.01, which we tested last year ("Beyond Unix," May 27, 1997). The most

significant changes with Netscape's 3.*x* releases are in workgroup-based content management, Lightweight Directory Access Protocol (LDAP) integration, hardware-based SSL support, and Java servlets. Netscape Enterprise runs on many platforms, including NetWare, five flavors of Unix, and Windows NT. We tested under Windows NT but also did performance testing under Solaris. (We review Novell Netscape Enterprise Server Pro for NetWare separately.)

In case you want to build Web applications and not just Web sites, Netscape Enterprise provides an excellent foundation, offering more programming flexibility than any other server. For application creation, Netscape Enterprise provides several routes for the developer in addition to standard CGI. For higher performance than CGI offers, the Netscape Server API (NSAPI) lets developers write in-process server applications. For Java developers, Netscape Enterprise supports the Sun Java Servlet API for server-based applications.



In Netscape Enterprise Server for NetWare, the hierarchical Access Control Rules let each rule override a previous one.

Netscape Enterprise also comes with the LiveWire runtime environment, which lets applications written using server-side JavaScript tools (such as Netscape's Visual JavaScript) run on the server. LiveWire is a scripting environment—similar to Microsoft's Active Server Pages—that lets developers create simple Web applications using JavaScript, which is easier to learn than Java or C++. LiveWire combines JavaScript scripting with a number of prebuilt server objects that automate tasks such as session maintenance, parsing CGI environment variables, and application initialization. LiveWire also provides native connectivity to many databases, including Informix, Oracle, and Sybase, along with ODBC access to other sources.

Whether you're running NetWare, Unix, or Windows NT, you administer your Netscape Enterprise servers with a Web-based application called Server Manager. For the most part, this set of JavaScript-enabled HTML forms is straightforward and easy to use, letting you specify server settings for areas such as security, users and groups, and content management.

But the Web interface still makes some tasks arduous. Adding users and groups is a major hassle, because you have to go through multiple selection steps to create users and add them to groups.

Most who have large user lists will bypass Server Manager and use the much more useful LDAP capabilities in Netscape Directory Server. Using this bundled product, administrators create LDAP Data Interchange Format (LDIF) files to add large numbers of users and groups.

For the Webmaster, Netscape Enterprise's content management features can put a lot of power in users' hands, making the product a good choice for intranet environments. You can create Netshares, personal home directories for each of your users. Working with Netscape Enterprise's Web Publisher, users of all technical levels can then upload content from their local computers to their Netshares on the server. The user-friendly interface in Web Publisher enables content creators to publish directly to the Web without forcing them to learn FTP or other networking concepts. No other Web server comes bundled with such a powerful decentralized content creation and publishing solution, and that makes Netscape Enterprise stand out from the pack.

Netscape Enterprise also comes with indexing and document conversion utilities. It bundles a Verity search engine that lets users create full-text indexes for documents stored in many formats, including Adobe PDF, Microsoft PowerPoint, and Microsoft Word. The product also comes with content conversion tools from Inso Corp., which automatically convert documents from native file types to HTML.

Netscape Enterprise implements SSL 3.0 and *x*.509 digital certificates, so you can provide secure access to your documents. Although we were unable to test them, Netscape Enterprise also works with third-party SSL hardware accelerator devices to increase performance during SSL handshakes.

Netscape Enterprise performed solidly on most of our tests, finishing in the top tier on our static HTML tests. Netscape Enterprise on Solaris outpaced the Windows NT version, and both finished behind Microsoft IIS after 36 clients. Running NSAPI produced impressive results on both platforms, although the Solaris results were significantly better than those on Windows NT. On the CGI tests, neither version performed particularly well; you would be better off using one of Netscape's alternatives to CGI, such as NSAPI.

All in all, the feature set within Netscape Enterprise is the best in the group. If your development efforts are focused around Java and multiple platforms, then Netscape Enterprise makes a lot of sense for you.—*John Garris*

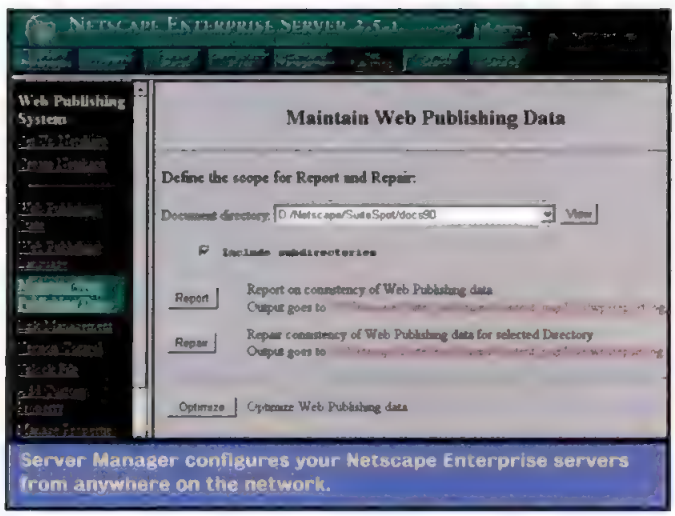
Netscape Enterprise Server Standard Edition 3.5.1. List price: $1,295. Netscape Communications Corp., Mountain View, CA; 650-937-2555; www.netscape.com. *Choose 559 at www.pcmag.com/infolink.*

Novell Inc.

Novell Netscape Enterprise Server Pro for NetWare

Many medium-size and large companies have at least one NetWare server connected to their LANs, so the idea of using that machine as a Web server is appealing. Novell Netscape Enterprise Server Pro for NetWare is the product of a collaboration between Novell and Netscape to offer Netscape SuiteSpot products for the Net-

Ware platform. This is basically the same Web server as the Windows NT and Unix versions of Netscape Enterprise Server Standard Edition 3.5.1, although it lacks a few Java agents to automate certain tasks and a Java Virtual Machine (JVM). Novell Netscape does offer excellent integration with NetWare's Novell Directory Services (NDS) and LDAP, as well as a five-user license of Oracle database and Netscape's Web publishing and searching tools. These tools give Novell Netscape much more functionality than that found in the Web server bundled with IntranetWare.



Server Manager configures your Netscape Enterprise servers from anywhere on the network.

Like all NetWare server–based applications, Novell Netscape runs as a set of NetWare Loadable Modules (NLMs) directly on the server. But unlike most NetWare applications, which require manual loading of NLMs, Novell Netscape makes installation easy by providing the first NetWare server installation we've seen that automatically installs the NLMs on the server without using the server's keyboard or Rconsole. In fact, the installation even installs TCP/IP and long-filename support on your server, if it is not already so configured. You must use the Novell Client 32 NetWare drivers on your Windows 95/Windows NT PC, though, or the installation wizard will not work.

Although installing the software is fairly easy, we did encounter a few problems creating our users. Novell Netscape lets you use your own user names and passwords, LDAP users and passwords tied into your NDS tree, and Netscape's Directory Services. We had problems using the Novell LDAP gateway to create users who would also appear in the NDS tree, however, and found that we needed to use the NetWare utility NWAdmin because of a flaw with the gateway that prevented us from using the Web-based management utility. The gateway should be repaired by the time you read this. If you use the Web-based management utility at all, though, you must use Netscape Navigator 3.0 or 4.0. Novell Netscape uses a lot of JavaScript code that doesn't perform well in Microsoft Internet Explorer.

You can create powerful security scenarios with Novell Netscape, based on user names, IP addresses, and domain names. You can limit users to reading, writing, executing, listing, and deleting tasks. Novell Netscape works with SSL 3.0 and includes a utility to create private certificates for testing or intranet use. For public SSL connections, Novell Netscape lets you create key pairs so you can request a trusted certificate from third parties such as VeriSign.

Creating content directories is easy when creating both physical and virtual links to files on your NetWare file server. You cannot connect and share files located on another NetWare server or another Web server. Most of the other Windows NT Web solutions, such as Lotus Domino Go Webserver Pro 4.6.1 and WebSite Professional 2.1, do provide this capability.

In contrast to using Windows NT, adding multiple IP addresses to a single network adapter was difficult under NetWare. A workaround is available, but you must edit a configuration file directly on the server, and the process isn't documented in the online manuals. The fix is posted on Novell's Web site.

Novell Netscape was disappointing on our performance tests. Its static HTML scores were near the bottom for this group, peaking early and falling well behind those of Netscape Enterprise Server Standard Edition 3.5.1 on Windows NT and Solaris. The in-process LCGI tests delivered results that measured about the same as those of its static HTML load.

The Novell solution offers the proven functionality found in Netscape Enterprise, such as powerful content management and improved searching utilities. If your needs are simpler, though, the built-in Web server in IntranetWare is free and may be a better choice for you.—*SR*

Novell Netscape Enterprise Server Pro for NetWare. List price: With five-user development and user license for Oracle 7, $1,995. Novell Inc., Provo, UT; 888-668-6699, 801-802-6600; fax, 801-802-6609; www.novell.com. *Choose 558 at www.pcmag.com/infolink.*

O'Reilly & Associates Inc.

WebSite Professional

If you're not an experienced Webmaster but you still need to create and manage an intranet, O'Reilly & Associates' WebSite Professional 2.1 has all the tools you need to build a Web site—in a well-organized, easy-to-use package. The server software is flexible and provides you with everything you need to host Web pages on a Windows 95– or Windows NT–based PC. You also get the best documentation we've seen for a Web server. Where WebSite falls short of products such as Microsoft Internet Information Server 4.0 and Netscape Enterprise Server Standard Edition 3.5.1, though, is in its relatively lack of a Web-based tool for remote management and its lackluster performance.

WebSite's primary strength lies in ease of setup and management. The documentation is excellent, but we found that the two thick manuals weren't really needed for simply installing and configuring the server. A simple installation wizard provides interactive help to answer your questions during the installation routine.

You enter all of the WebSite configuration information using Server Properties, a Windows-based utility. This easily navigated program consists of a series of tabs that let you set up users and groups, configure access control, define your URL mappings, enable logging, and perform other maintenance tasks.

In addition to Server Properties, you also get WebView, another management program. Despite its name, WebView is a proprietary Windows-based utility. Unlike the properties utility, though, it is accessible only on the physical WebSite

server, not from a remote PC or a browser. WebView provides a two-pane window that we found even easier to navigate than the properties program, and it also lets you see all of your virtual servers from a single window.

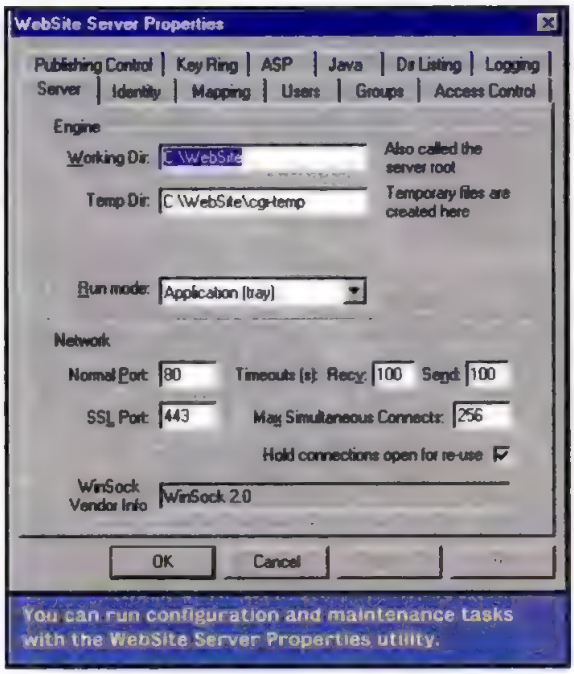
WebSite's only management flaw is the lack of a browser-based utility to enable easier remote management. You can run the properties utility on a remote Windows-based PC, but you must install the utility manually on every PC you want to use as a management station.

WebSite provides two options for setting up users: You can take the users and groups from your Windows NT database or create your own separate WebSite users and groups (or do both). This ability to use both security schemes is known as a two-tier approach and is unique among products in this roundup. In addition to restricting and allowing access based on user names and passwords, WebSite let us define access based on IP addresses and even host names. Like most of the other products in this roundup, WebSite works with SSL 3.0 to provide secure server connections.

If your site requires multiple host names and IP addresses on a single Web server, WebSite gives you several ways to perform the task. You can create multiple host names for the same IP address on the server, and you can also create multiple IP addresses for the same network adapter using Windows NT. These virtual servers are basically unlimited in number and in how they can be used.

You can also create IP-less virtual servers. For example, you can set up WebSite with multiple host names to the same IP address or create a host name that is not even bound to a particular IP address.

WebSite also bundles some notable content creation tools. iHTML Professional is a powerful server-side scripting tool that lets you embed instructions (such as if/then statements and math functions) inside your documents to perform certain tasks. The package includes Allaire Corp.'s excellent HomeSite (an Editors' Choice in "Web Authoring Tools," January 20, 1998) for Web site creation. For further programming needs, WebSite supports CGI and WebSite's own API (WSAPI). For Webmasters who have Microsoft IIS 3.0 installed, WebSite can use the Microsoft ISAPI DLLs to provide ISAPI support for ISAPI applications. It also includes the JDK 1.1 interpreter to let you create server-side Java applications both as servlets and through WebSite's own CGI-based Java interface.



You can run configuration and maintenance tasks with the WebSite Server Properties utility.

On our WebBench tests, WebSite finished last among Windows NT–based servers on our static HTML tests. The server still does not provide a configurable cache, though one is planned. In practice, this may not be a problem if your site does not get the high-level traffic that WebBench approximates.

WebSite's lack of browser-based management and poor performance on our stress tests may be drawbacks, but the product's full complement of tools and flexibility make it a good choice for less experienced or part-time Webmasters.—*SR*

WebSite Professional 2.1. List price: $799. O'Reilly & Associates Inc., Sebastopol, CA; 800-998-9938, 707-829-0515; www.oreilly.com. *Choose 560 at www.pcmag.com/infolink.*

StarNine Technologies Inc.

WebStar

Long the standard for Web serving on the Mac OS platform, StarNine Technologies' WebStar 3.0 ($499 list) is much improved from previous versions. A revamped administration application and significant new features such as basic FTP and proxy services, full-text indexing, and support for virtual domains make the product more flexible and easier to use. Current WebStar owners, Macintosh lovers, and those looking for the simplest Web server around will find much to like in this new release. Power-hungry Webmasters, though, are likely to decry the relatively poor performance and lack of common features such as logical URL mapping, SSL 3.0, site management tools, and database connectivity.

The new application WebStar Admin has an updated interface that displays the simplicity and elegance one would expect from a Mac. Each screen is well designed, and since the application runs over TCP/IP, you can use it on the server itself or on any IP-equipped Macintosh. Setting basic server settings such as MIME-type mapping and custom error pages is a breeze, as is creating users, security realms, and virtual hosts. Administration in WebStar is both quicker and easier than WebTen 2.0's Web-based administration.

But WebStar's administration tools are by no means perfect. Some CGI administration can take place only via a Web browser, but since you can't handle all administrative action via the browser, Webmasters must use two different programs to manage the server. WebStar Admin runs only on a Macintosh, so Webmasters are limited in their options if they are running heterogeneous environments.

Several architectural issues make some common Web server tasks overly challenging. If a user belongs in multiple realms (WebStar doesn't support groups), the administrator must create multiple instances of the user, one for each realm. WebStar cannot specify access by file or folder; instead, WebStar allows access based on incoming URLs, which can be a blessing or a curse, depending on your application. Similarly, WebStar offers no built-in facility for logical URL mapping or redirection, though workarounds and add-ins do exist. The accompanying documentation—provided in printed, PDF, and HTML formats—is well done and

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BENCHMARK TESTS

Web Servers

We found that all the servers tested could handle serving static pages with no problems. But adding dynamically generated content using CGI when serving pages revealed the greatest real-world differences between the products. Apache HTTP Server 1.2.5 and Microsoft Internet Information Server 4.0 proved to be the best hosts for dynamic sites using CGI, but we also observed that in-process APIs such as NSAPI and ISAPI produced much better performance than CGI could.

What the Numbers Mean

We began this year's Web server roundup with some questions on performance. Would Version 4.0 of Microsoft IIS be as good as its predecessors? Would Solaris 2.6 solve the Microsoft Windows 95 client communication problems we encountered last year with Solaris 2.5—problems that significantly hampered performance? Would any new contenders emerge from the pack? Would Novell Netscape Enterprise Server Pro for NetWare make NetWare a viable Web serving platform?

To find the answers to these questions, we armed ourselves with WebBench 2.0, the latest version of the Ziff-Davis Web server benchmark test program. WebBench 2.0, created from profile information from several high-traffic sites, is focused on stressing Web servers at the high end of the spectrum. The tests measure a server's performance delivering static pages as well as various mixes of static and dynamic pages. We found that given reasonably robust hardware like that used in our tests, none of the Web servers in this roundup would have any problem handling a reasonably large site that served only static pages. For example, a server handling an average of 200 static requests per second would be processing 720,000 requests an hour, which would be high traffic at just about any site at any time. (Some of the servers we tested could satisfy thousands of static requests per second.) But when we introduced dynamically generated pages into the mix, several of the products began to show signs of stress. The use of in-process APIs such as ISAPI and NSAPI may provide a reasonable workaround in that situation.

The standard WebBench 2.0 test suites use a total of 60 physical clients. We increased the load slowly by adding clients in increments of 4 until all 60 clients were running off the server. Each WebBench client performs the work of several real-world clients. We've found that testing with 60 WebBench clients is sufficient to get valid test results on even the fastest Web servers.

The WebBench 2.0 test results will give you a good idea of how well a Web server functions at various load levels. In the early phases of the test, you see the scores increase dramatically as Web servers cache more of the WebBench workload. As the number of clients participating in the test increases, you begin to see the result curve bend as the Web servers reach their peaks. In the later stages of the test, you see how well the Web servers maintain their performance under increasingly heavy loads. As the result graphs show, the better-performing Web servers peak higher and are able to maintain their peak performance over the life of the test.

WebBench 2.0's workload files, unlike those of previous versions, did not fit neatly into most Web server caches when we used the default settings. We knew that in order to get the maximum performance out of the Web servers, particularly with our static and in-process tests, we needed to increase the server cache to a level capable of caching the entire WebBench 2.0 workload if possible. Cache is less of an issue with our CGI tests, because the server load consists primarily of executing the CGI application and not servicing static page requests.

Static HTML tests under Windows NT We began with the standard WebBench static test suite, which makes HTTP requests for static data stored in the WebBench workload tree. In addition to text-only HTML documents, this static data now contains a variety of GIF images and a few larger binary files.

At the largest client load, Microsoft IIS clearly proved to be the fastest product in the group, but Netscape Enterprise Server Standard Edition 3.5.1 proved more than adequate for even a very high-traffic site. All of the Windows NT products will do fine serving static pages on most other sites with lower traffic; you're more likely to be limited by network factors other than the Web server software.

Based on the performance of its predecessors in past years, Lotus Domino Go Webserver Pro 4.6.1 surprised us with a very strong performance under Windows NT, but we were highly suspicious of the product's method of getting there. Go Webserver forces you to create a list of the files to be cached instead of automatically generating one, so we had to endure the arduous task of manually adding 6,010 lines (one for each unique file in the WebBench workload) to the configuration file. Asking the Webmaster to maintain this list continually is impractical.

We tested Sun's Java Web Server 1.1 for the first time this year. With a good start for up to eight clients but a disappointing flat-line performance after that, Java Web Server was not among the top finishers. O'Reilly's WebSite Professional 2.1 finished last in our Windows NT testing. WebSite is the only Web server tested that does not provide its own cache, which hurts its performance. Looking at the issue from a real-world perspective, though, it's fair to say that in practice this may not be a problem—depending on the size, content, and traffic level of your Web site. In other words, WebSite is a fine choice for running lower-traffic sites.

Static HTML tests under Solaris The real surprise of our testing came when we began static HTML testing under Solaris. Last year, our testing revealed a problem between Solaris 2.5 and our Microsoft Windows 95 clients that caused Solaris-based Web servers to perform below expectations. This year, we found that the workaround Sun provided to allow efficient communication between Solaris 2.6 and the Windows 95 TCP/IP stacks used by WebBench 2.0 clients solved the problem,

resulting in significant performance increases. For details on the TCP/IP stack communication problem and the workaround, go to *www.sun.com/sun-on-net/performance/tcp.slowstart.html.*

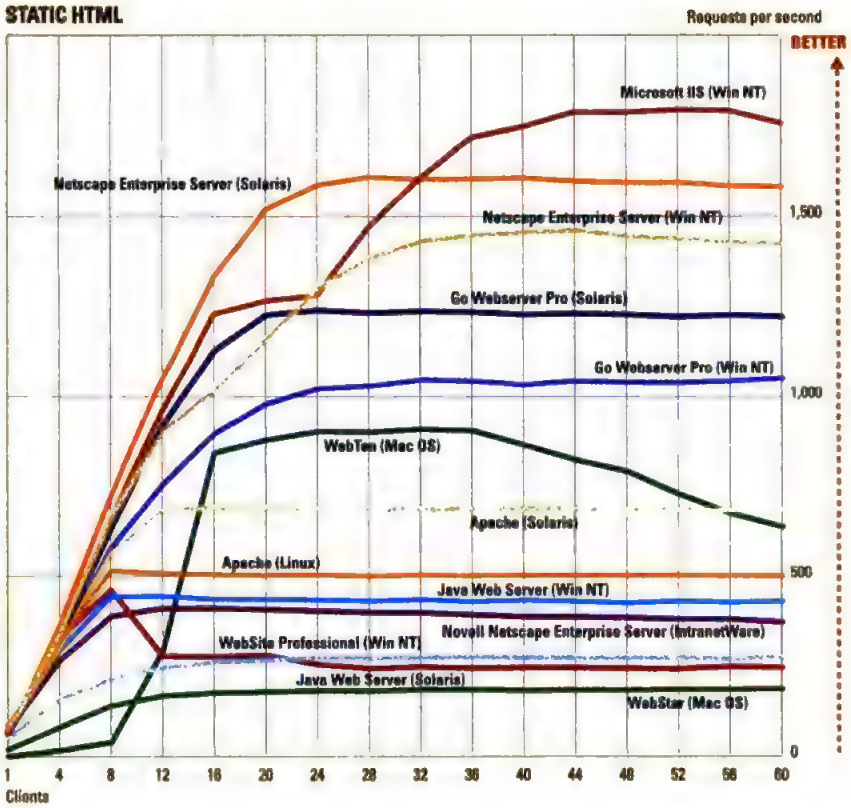
In our testing, Netscape Enterprise on Solaris finished solidly ahead of its counterpart on Windows NT and was second only to Microsoft IIS. Netscape Enterprise actually performed faster than Microsoft IIS at 28 simultaneous clients and fewer. Apache on Solaris turned in a good performance, finishing in the lower middle of the pack. Sun's Java Web Server on Solaris started off along the same path as Java Web Server on NT, then dropped dramatically after 8 clients to finish near the bottom of the pack. Such a sudden drop in results generally indicates that the Web server has run into a bottleneck of some kind that additional tuning and analysis might improve, but Sun was unable to provide a solution.

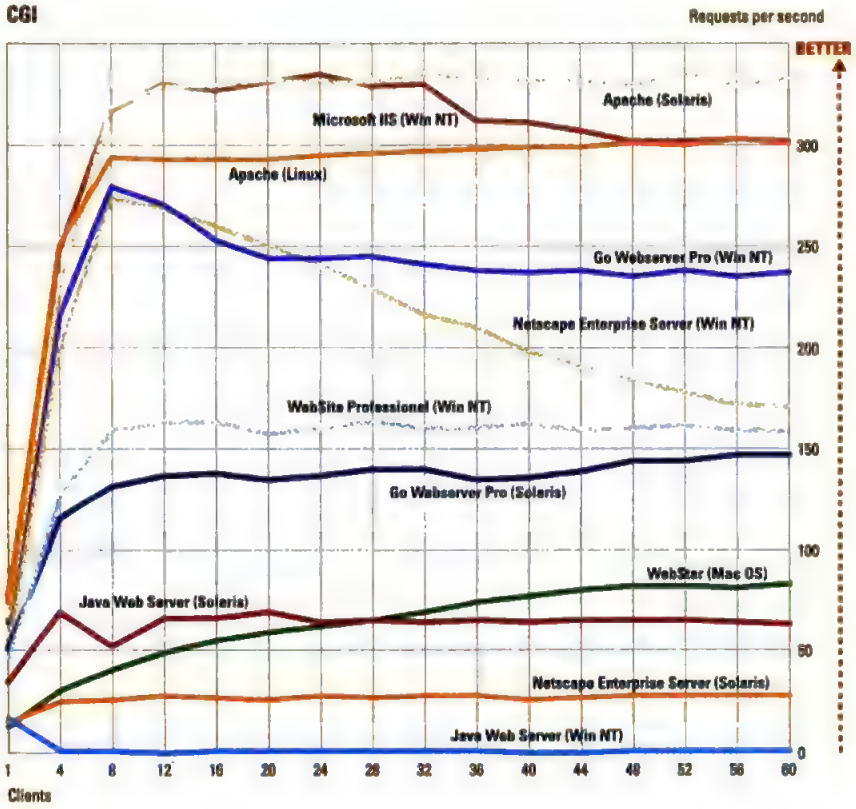
Additional static HTML tests on Intel-based hardware We also tested Apache on Red Hat Linux 5.0 and Novell Netscape running under IntranetWare on *x86* server boxes. Apache on Red Hat Linux produced poorer results than Apache on Solaris, though Linux does not support symmetric multiprocessing as Solaris does, meaning that we were really taking advantage of only one processor instead of two. We had high expectations for Novell Netscape ported to NetWare as a Web serving platform, and we were disappointed that it couldn't keep up with Netscape Enterprise on Windows NT and Solaris.

Static HTML tests under Mac OS WebTen 2.0 on Macintosh produced the best scores we've ever seen running WebBench against a Macintosh server. The server is a version of Apache that lets users bypass Mac OS's Open Transport stack in favor of a proprietary stack. WebTen started slow, because it spent the first few mixes satisfying requests from disk while at the same time loading up its cache. Once the workload was cached, the results increased to quite respectable levels and then leveled off early.

In-process and CGI tests This next series of tests make a combination of static requests and either in-process (NSAPI, ISAPI, LCGI) or out-of-process (CGI) requests to the server. The WebBench in-process modules get loaded into the Web server process space and perform better because of lower overhead as compared with CGI modules. The same

continues





BENCHMARK TESTS

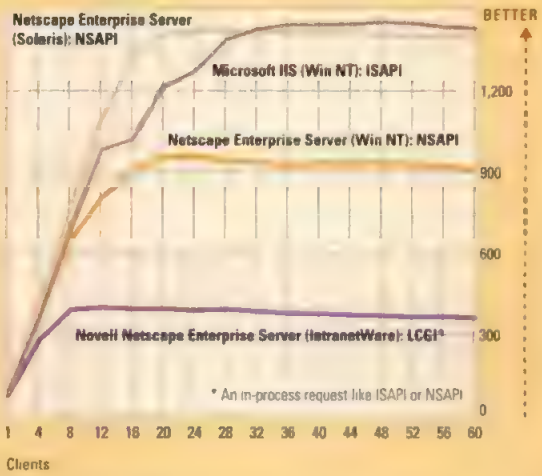
forces that shape the static results—cache management and effective client/server communications—play an important role here.

The four servers tested on the in-process tests impressed us by being able to provide results comparable with their static HTML test results.

Handling CGI requests proved much more difficult. In the CGI test our fastest server, Apache on Solaris, maxed out at 333 requests per second. In the static tests, all but two of the products in this roundup served up more than that. Netscape Enterprise running on Windows NT started strong, only to drop off sharply after 8 clients, while Enterprise on Solaris never seemed to get started. As the client load increased, the average time required to service a request increased to the point where Enterprise on Solaris required more than 2 to 3 seconds, on the average, to complete each request with a 60-client load. In contrast, Apache on the same platform took only 180 milliseconds on the average to service a request with a load of 60 clients. If you are building a large site that uses a lot of dynamic content, you'll want to opt for one of the top performers or consider using applications that serve requests in process, if possible.

Unfortunately, WebTen on Macintosh was not able to complete the CGI tests. The load the CGI tests placed on the server caused the Web server to stop servicing requests. We worked with WebTen engineers but couldn't find a solution before we went to press.—*Analysis by Ben Gottesman, Chris Lemmons, and Jay Munro*

IN-PROCESS



How We Tested

Our Web server testing consisted of two components: features testing and performance testing. We tested features at PC Labs in New York City and did performance testing at ZD Labs in Foster City, California.

We tested features by inviting the reviewers and vendors into the Labs for two days of hands-on testing. Our test script gave reviewers a series of tasks as a common reference point so we could compare fairly across the field of Web servers. The tasks included setup and installation, server management, administration and access control, SSL and security implementation, content and site management, complex page handling, APIs, CGIs, server-side includes (SSIs), and servlets. We also looked at mirroring and staging, multiserver, and transaction support. Since Web servers generate statistical information that can be crucial to learning about your customers, we also looked at logging and analysis support. And we considered features that help you keep a server running: documentation, help files, and service and support.

Before we started performance testing, we invited vendors to come to ZD Labs and install and configure their Web server software on our test servers. This was an effort to find the best way to tune each Web server. As a general rule, we always disabled Web server logging in an effort to maximize performance.

We tested all products using WebBench 2.0. This version contains a number of improvements over its predecessor. First and foremost is the new test workload. Engineers at the Ziff-Davis Benchmark Operation (ZDBOp) set out to develop a workload for WebBench 2.0 that reflected the types of traffic and file sizes seen on real-world, large-volume Web sites. To accomplish this task, ZDBOp solicited and analyzed raw Web server log files from such popular sites as the Internet Movie Database, Microsoft, USA Today, and ZDNet.

The WebBench 2.0 workload contains 6,010 files, ranging in size from 200 bytes to 550K. These files take up approximately 63MB of disk space. We modified the Web server cache settings for each server we could, increasing the capacity to 70MB, in order to accommodate the entire WebBench 2.0 workload and give each server the opportunity to achieve maximum performance.

For this year's Web server roundup, we used dual-processor machines with 512MB of main memory. Our goal was to test the Web server and not to impose limitations on it, such as forcing it to go to disk too often. We put the server on two 100-Mbps switched subnets so as not to saturate our Fast Ethernet network.

The test-bed consisted of 40 Dell Dimension XPS P200s systems and 20 Dell Dimension XPS P166s clients, the Web server, and the benchmark test controller. The clients were evenly divided on the two 100-Mbps switched Ethernet networks connected to four Synoptics 28115 10/100 16-port switches. Each Windows 95 client had 32MB of DIMM memory, a 1GB hard disk, and Intel PCI UTP Pro 100B NICs. The benchmark controller was an HP NetServer LH Plus with a 166-MHz Pentium processor, 64MB of RAM, and a 2GB hard disk. The controller collected the results and managed the progress of the test from 1 client to the full 60 clients.

Compaq supplied the Intel-based box—the Compaq ProLiant 1600R Server, which had dual Pentium II/266 processors, 512MB of DIMM memory, and three 4.3GB SCSI hard disks. We used two Compaq Netelligent 10/100 PCI UTP NICs except for the Linux tests, where we used two Intel PCI UTP Pro100B NICs because of driver availability.

For the Sun Microsystems platform, we used a Sun Ultra Enterprise-II with dual UltraSparc-II 296-MHz processors to run the tests. This machine had 512MB of RAM, two Lance 100-Mbps NICs, and seven 4.3GB hard disks.

Apple provided the Labs with the newest Apple G3 Server powered by a 266-MHz processor. With the new Apple 10/100D, this machine can support two Apple 10/100 PCI UTP NICs using AppleTalk but not IP. Tenon Intersystems' WebTen 2.0 was able to use the two NICs, because of Tenon's option of replacing Apple's slower Open Transport with Tenon's own implementation of the TCP/IP stack. We also tested StarNine's WebStar 3.0 while the product was in public beta. WebStar's use of Open Transport prevented it from using two NICs, but the unit did well with Apple's OT on one subnet of 60 clients.—*Analysis by Jay Munro and Brad Walden*

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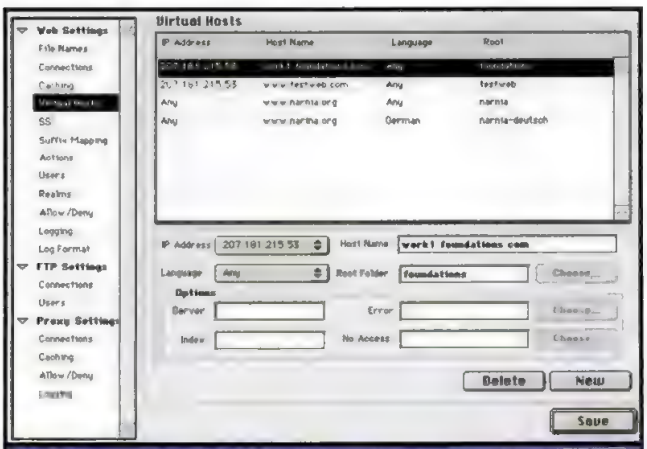
does help, as do the references to online FAQs and other resources.

WebStar offers extremely flexible support for virtual hosts, allowing IP-based hosts when using Apple's Open Transport 1.3 networking stack, as well as Host Header Field–based virtual hosts and language-based virtual hosts. Administrators can designate any combination of IP address, host name, and language and designate a root folder for that combination.



WebStar creates virtual hosts based on any combination of IP address, host name, or language.

Macintosh users no longer need to run Apple File Sharing in order to update files on the Web server, as StarNine has included a basic FTP server in WebStar 3.0. The FTP server supports both anonymous and authenticated access, although the users defined for FTP are different from those defined for Web access.

Other advanced features include a full-text indexing solution that provides indexing and searching on text, HTML, and Adobe Acrobat files. Though the indexing application itself has a few design flaws, such as the inability to exclude subfolders from indexing, we successfully created a scheduled index event and were able to search both Web pages and Acrobat files.

Although WebStar offers full SSL 2.0 support by running a separate instance of the server, you cannot get SSL 3.0 support. The server doesn't support client certificates and digest authentication either, and as a result, users with newer Web browsers may experience problems accessing WebStar-hosted secure sites unless they change their settings. Those hoping to run multiple secure sites with WebStar will be disappointed, since WebStar supports SSL only on a single IP address; no facility for supporting multiple certificates on multiple IP addresses exists.

You can extend the scope of WebStar to incorporate database access, chat rooms, and bulletin boards. WebStar supports standard Apple event-based CGIs and provides W*API, a now-standard API for in-process CGI execution. WebStar includes a variety of freeware and demonstration applications. It doesn't bundle full-featured traffic reporting, site management, or content creation utilities.

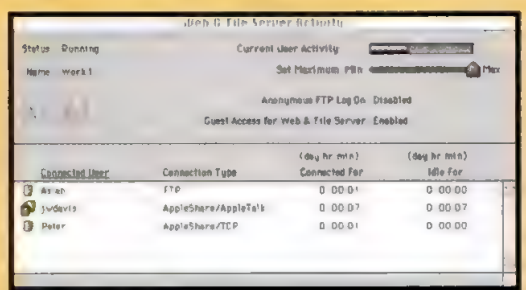
WebStar's performance was predictably poor compared with that of the rest of the products in the roundup, because of its reliance on Open Transport in the Mac OS for networking. WebStar finished last on our static HTML tests, performing at less than 25 percent of WebTen 2.0's result when we measured each at peak output. CGI test results were also poor.

Preview: AppleShare IP 6

Apple has obviously taken note of Microsoft's success in positioning Windows NT as an all-in-one solution for LAN and Internet services. Last year's release of AppleShare IP 5.0 marked Apple's first effort to create a similarly integrated server product for the Macintosh, offering file, print, Web, and mail services in a single, easy-to-use package. Version 6, slated for release this summer, aims to improve performance, add functionality, and offer greater support for mixed Macintosh and Windows environments.

AppleShare IP currently provides basic Web services with a focus on ease of use. In addition to its Web capabilities, AppleShare IP incorporates FTP and mail services. Version 6 will include a completely revamped mail system that will enable POP3/SMTP mail servers as Version 5.0 does, but it will also support the IMAP4 standard and offer improved performance.

As the name indicates, AppleShare IP not only supports AppleTalk-based file services but lets Macintosh clients access Macintosh servers via TCP/IP. Using TCP/IP improves performance and lets Macs coexist more peacefully on networks where AppleTalk is not routed. In addition, Version 6 will provide SMB client support, letting Windows 95 and Windows NT clients access AppleShare servers natively. AppleShare servers will appear in Network Neighborhood just like Windows NT–based servers, and administrators need not worry about AppleTalk anywhere on their network.



AppleShare's Web and File Server supports Web, FTP, and Appletalk. Version 6.0 will add SMB client supports.

Printers in AppleShare IP 6 can be secured using AppleShare's user account database. The print spooler now supports TCP/IP, printing to TCP/IP–enabled print devices, and accepting print jobs from configured Windows NT and Unix workstations.

All AppleShare services share a single, integrated administration interface based on Apple's OpenDoc technology. Although an Apple spokesperson says that the company intends to continue using OpenDoc, a Web-based administrative interface will be available around the time Version 6 is released. AppleShare IP 6 prices were not available at press time.—*JWD*

SUMMARY OF FEATURES

Web Servers

PC MAGAZINE EDITORS' CHOICE

■ YES ▨ NO	Apache HTTP Server 1.2.5	Java Web Server 1.1	Lotus Domino Go Webserver Pro 4.6.1	Microsoft Internet Information Server 4.0	Netscape Enterprise Server Standard Edition 3.5.1	Novell Netscape Enterprise Server Pro for NetWare	WebSite Professional 2.1
List price	From the Apache Group, free; with Red Hat Linux, $49.95	$295	$595	With Windows NT 4.0 or NT 4.0 Option Pack, free; with 5-user license, $809	$1,295	With 5-user development and user license for Oracle7, $1,995	$799
Platforms supported	AIX, BSD/OS, FreeBSD, HP-UX, Irix, Linux, QNX, SCO, Solaris	Solaris 2.5.1; Windows 95, NT 4.0	AIX; HP-UX; OS/2; OS/390; Solaris; Windows 95, NT	Windows NT 4.0	AIX 4x; Digital Unix 4.0b; HP-UX 10x; Irix 6.2; Solaris 2.51, 2.6; Windows NT 3.51, 4.0	NetWare	Windows 95, NT
Allows a separate administrator for each virtual server	■	▨	▨	■	▨	▨	▨
Browser-neutral access to host header sites	■	■	■	■	■	■	▨
Supports multiple ports/automatic URL redirection	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	▨ ■
Can scale to multiple processors	■	■	■	■	■	▨	■
Can act as a proxy server	■	■	■	▨	▨*	▨	▨
Built-in search engine	▨*	▨	■	■	■	■	■
Searches observe security settings	■	■	■	■	■	■	■
Automatically reindexes when a file is changed, added, or deleted	▨	▨	▨	■	■	■	▨
Browser/imagemap-builder utility	■ ▨*	▨ ▨	■ ■	■ ■	■ ▨	■ ■	■ ■
HTML authoring tools	■	▨	■	■	■	■	■
Supports PICS ratings/Custom error pages	■ ■	▨ ■	■ ■	■ ■	▨ ■	▨ ■	▨ ▨
Supports FTP/Gopher	■ ▨*	▨ ▨	■ ■	■ ▨	▨ ▨	▨ ▨	▨ ▨
Supports NNTP/POP/SMTP	■ ■ ■	▨ ▨ ▨	■ ■ ■	■ ▨ ■	▨ ▨ ▨*	▨ ▨* ▨*	▨ ▨ ▨
Configuration and Management							
Can be managed from server console/Web browser	■ ■	■ ■	■ ■	■ ■	▨ ■	■ ■	■ ▨
Can monitor current connections	■	▨	■	■	■	■	■
Can monitor CGI, ISAPI, and NSAPI requests	■ ■ ■	▨ ▨ ▨	▨ ▨ ▨	■ ■ ■	■ ▨ ■	■ ▨ ■	■ ■ ■
Can monitor bytes sent and received	■	▨	■	■	■	■	■
Wizards for creating new sites and directories	▨	▨	■	■	▨	■	■
Can start and stop Web servers remotely	■	■	■	■	■	■	▨
Logging							
CERN/NCSA common log format	■ ■	■ ■	■ ■	▨ ■	■ ■	■ ■	■ ■
Limits logging on a per-directory/per-file basis	■ ■	▨ ▨	■ ■	■ ■	■ ■	■ ■	▨ ▨
Reporting tools	▨*	■	■	■	■	■	■
Filters domains/users/IP addresses	■ ■ ■	■ ▨ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ▨ ▨
Security and Directory Support							
Password/challenge-response authentication	■ ▨	■ ▨	■ ■	■ ■	■ ■	■ ■	■ ■
Digital certificate authentication	■	■	■	■	■	■	▨
LDAP authentication/SSL 3.0	▨* ▨*	▨ ■	▨ ■	▨ ■	■ ■	■ ■	▨ ■
Creates a private X.509 certificate/wizard	▨* ■	■ ■	■ ■	■ ■	■ ■	■ ■	▨ ▨
Access control handled by operating system/server	■ ■	▨ ■	▨ ■	■ ■	▨ ■	■ ■	■ ■
Access control handled by domain name/IP address	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Includes wizard for key pair	▨	■	■	■	■	■	■
Directory name server/Directory maintenance utility	■ ▨*	▨ ▨	■ ■	■ ■	■ ■	■ ■	▨ ▨
Applications Development							
CGI/WinCGI	■ N/A	■ ▨	■ ■	■ ■	■ ■	▨ N/A	■ ■
NSAPI/ISAPI	▨ ▨	▨ ▨	▨ ▨	▨ ■	■ ▨	■ ▨	▨ ■
Other APIs	Apache	Java servlet	Go Webserver	None	Java servlet, WAI	None	Java servlet, WebSite Servlet, WSAPI
Allows SSIs (Server Side Includes)	■	■	■	■	■	■	■
Supports ASP/Java servlets	■ ▨*	▨ ■	▨ ■	▨* ▨*	▨ ■	■ ■	■ ■
Database Connectivity							
Supports ODBC	■	▨	■	■	■	▨	■
Native Oracle/Sybase	■ ■	▨ ▨	■ ■	▨ ▨	■ ■	■ ■	▨ ▨
Native Microsoft SQL Server/DB2	■ ■	▨ ▨	▨ ■	■ ▨	■ ■	▨ ▨	▨ ■
Includes and bundles database	■	▨	▨	■	▨*	■	▨
Legacy connectivity	■	▨	▨	■	■	▨	▨

N/A—Not applicable: This product does not support Windows. * Available via a separate product or a third-party option.

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The Benchmark

If you are interested in ease of use and a strong feature set for Web serving on the Mac platform, WebStar is an excellent choice. For performance, WebTen is a better solution.—*J.W. Davis*

WebStar 3.0. List price: $499. StarNine Technologies Inc., Berkeley, CA; 800-525-2580, 510-649-4949; www.starnine.com. *Choose 561 at www.pcmag.com/infolink.*

Tenon Intersystems

WebTen

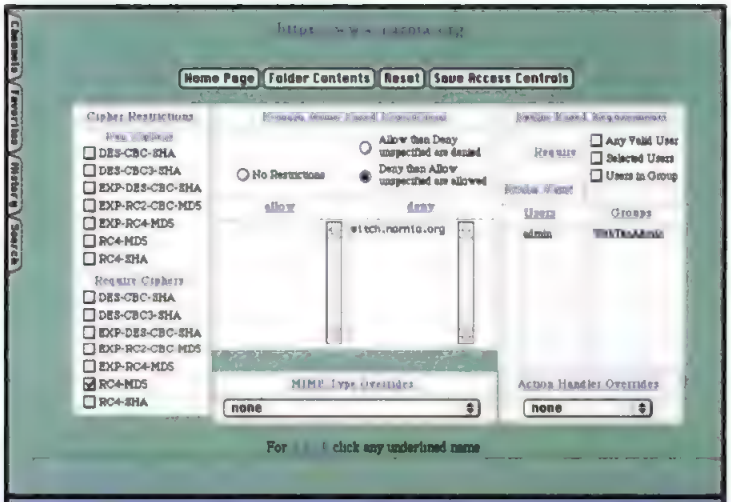
A Mac OS version of Apache HTTP Server 1.2.5 designed to be easier to administer than a standard Apache implementation, Tenon Intersystems' WebTen 2.0 has a simple installer, an HTML-based administrative interface, and well-written documentation. It is not as easy to use as StarNine Technologies' WebStar 3.0 for the Mac OS, but its performance is on a par with some Unix-based products. That and its advanced functionality, such as virtual host–capable SSL 3.0, make it more powerful than WebStar 3.0.

Tenon has wrapped Apache in a Unix virtual machine so the server runs on the Macintosh. Anyone who has been frustrated setting up Apache on a Unix box will appreciate WebTen, and even Mac users will feel right at home. Setup requires only a few simple mouse clicks. WebTen picks up your network settings automatically and configures a default virtual host for you; the server is up and running in about 5 minutes. You handle further configuration via the Web-based administrative interface.

We found WebTen's Web-based administration to be generally capable. Creating users and groups is straightforward, as is assigning file and folder access based on user name, group membership, or host name and IP address. We had no difficulty setting up logical URL mapping or redirects. Managing virtual hosts was a snap: Simply enter the new host name and click the Add Virtual Host button. WebTen automatically determines what type of virtual host is required (IP- or host header–based), creates the root directory if necessary, and causes all the host settings to be inherited from the general system configuration. Individual settings can then be overridden as necessary. Administrators also can use a Web browser to customize the configuration of other features such as FTP, DNS, cache, proxy, and security.

Although WebTen's Web-based administration is as good as any browser-based management GUI in this roundup, it is not as strong as a client-based application such as those in WebSite Professional 2.1 and Microsoft Internet Information Server 4.0. A few of WebTen's more advanced features require hand editing of text files, and HTML's inherent limitations at times keep the interface from being as elegant as it could be.

You can likely handle most administration questions with the well-written and thorough documentation. The documentation comes in three forms: a manual, an Adobe Acrobat file, and a compilation of HTML pages linked directly to commands in the administration screens.



WebTen's Access Controls secure files and folders by user, group, host, IP address, or SSL cipher.

Those looking for comprehensive site management capabilities will find WebTen lacking. You get no tools for traffic analysis and reporting, full-text indexing, or content creation and management. Also missing is support for database access and intranet applications such as discussion forums and chat rooms. Instead, Tenon points Webmasters to public-domain solutions that can be integrated into WebTen.

WebTen offers better functionality and extensibility than WebStar and stacks up pretty well against its Unix cousin Apache. WebTen supports Apple-event CGI applications and StarNine's popular W*API for plug-ins. In addition, you can expand WebTen using specially ported modules, the Apache standard for in-process CGIs. WebTen currently supports Java servlets via a W*API plug-in and the Mac OS Java VM, but in the future it might handle them via an Apache module for better compatibility and performance.

Webmasters can use any of these interfaces to add database access and other functionality. Setup is easy enough: Drop a script or application with the appropriate suffix (.acgi, .pl, .sh, and so on) into the CGI-BIN folder and WebTen sorts it out. Development is tougher. While Tenon sells a development environment for creating CGIs, you get no bundled utilities for creating or testing non-Apple scripts and CGIs.

For static HTML page serving, WebTen turned out the best numbers we've ever seen for a Mac Web server. Its performance was in the middle of the pack, but it was better than Apache under Linux and Solaris and dramatically better than WebStar. The server started slowly, because it served from disk until the cache was loaded, but once that happened, the program performed well. WebTen could not handle the load of our CGI mix and failed to complete the tests.

WebTen also provides strong security mechanisms. These are easily managed, though not always elegantly so. You can configure any of WebTen's virtual hosts for SSL 3.0 with keep-alive support, though if you want both normal and secured access, you must create a second instance of the virtual host.

If you need performance on the Mac platform and features that WebStar doesn't support, such as SSL 3.0 security, WebTen should be your choice.—*JWD*

WebTen 2.0. List price: $495. Tenon Intersystems, Santa Barbara, CA; 888-293-2836, 805-962-8202; www.tenon.com. *Choose 562 at www.pcmag.com/infolink.* PC

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POWER PQ QUEST

THE New Net

PC Labs tested seven Net PCs and five thin clients/Windows-based terminals and examined the state of Java-based NCs.

By Tami D. Peterson and Anush Yegyazarian

Centralized computing has been around since the inception of the computer. Until recently, however, PCs in most companies have escaped centralized management. And more and more, IS managers have seen the depth of problems that has created.

Asset management in large installations has been the most serious problem: Between sanctioned upgrades and user tweaks, administrators often haven't known what hardware or software was on users' PCs. Software distribution itself has been time-consuming, usually involving IS support staff going from PC to PC, either installing the software manually or at least taking time to configure it so that it didn't interfere with anything else already installed. In many cases, departments had separate budgets, acquired disparate PCs from multiple suppliers, and in general created nightmarish environments for which support was costly. In addition, users were introducing viruses through their own software installations and downloads. All of that increases the total cost of ownership (TCO)—a no-no in today's budget-conscious environment.

Ever since the Gartner Group released a study on PC costs more than two years ago, lowering TCO has been *the* hot topic. Specifics vary with each company, but one idea emerges consistently: desktop management. By promising to return some measure of control to IS, managed corporate PCs and new alternative client platforms such as Net PCs, NCs (network computers), and Windows terminals are beginning to find a place in corporate America.

Here are some basic distinctions among the three classes of networked systems tested by PC Labs. Some of the systems we tested blur the lines, combining aspects of more than one category. The right solution for you depends on your current setup and future needs.

REVIEW CRITERIA

Managed solutions come in many types. We chose to focus on available systems of the new breed—Net PCs, thin clients (including Windows terminals), and NCs—platforms

PHOTOGRAPHS BY THOM O'CONNOR

Thin client/Windows terminal

Where user tasks are narrowly defined—repeated data entry or single-application use, for example—and users don't need the power of a full PC, thin clients provide great security features and lots of control, with central processing and management of Windows applications.

- **All processing is performed on the server.**
- **Usually has no hard disk, floppy disk drive, CD-ROM drive, or expansion slots.**
- **Uses a low-level processor, such as a 25-MHz Intel i960 RISC.**
- **Runs with servers using Microsoft NT and Citrix WinFrame or the forthcoming Microsoft Windows Terminal Server for thin clients and Citrix pICAsso, using RDP or ICA protocol.**

worked COMPUTERS

Net PC

The centrally managed Net PC provides administrators with systems that have the power of standard PCs but with greater control and security. It is the result of an initiative spearheaded by Compaq, Dell, Hewlett-Packard, Intel, and Microsoft in August 1997.

- **Has an internal hard disk and can run applications locally.**
- **Cases should be sealed, lockable, and tool-free; floppy disk and CD-ROM drives are optional.**
- **Requires a 133-MHz Pentium or better and 16MB of RAM or more.**
- **Supports Wake on LAN for remote management and OnNow for instant boot-up.**
- **Runs a Microsoft Windows OS; software distribution should be centralized.**

Java NC

NCs are architecturally neutral and centrally managed, and they should be easier to use and more secure than PCs; they also offer the potential for direct connection to a variety of OSs. This reference profile was proposed by Apple, IBM, Netscape, Oracle, and Sun in August 1996.

- **Downloads applications to memory and runs locally.**
- **Hard disk, floppy disk drive, CD-ROM drive, and ISA slots are not required.**
- **Low-level CPU such as a 25-MHz Intel i960 RISC and 32MB of RAM or more recommended.**
- **Has a minimum display resolution of 640-by-480, text input capability, audio output capability, and a pointing device.**
- **Runs Java Virtual Machine (JVM).**
- **Supports IP as underlying protocol.**

that are much more server- and network-centric than traditional PCs. (For an in-depth examination of network and server loads and the ease of deployment of thin clients and Net PCs, see "Thin Clients, Fat Server, Robust Networks" in the Net Tools section. We also include a special pullout section, "Choose Your TCO Strategy," to help you make your platform decision.)

We sought systems from select vendors. Net PCs had to comply with the Net PC specification (see "Division of Labor" below) and have 32MB of RAM, a 1GB hard disk, Ethernet connectivity, Microsoft Windows NT 4.0, and preferably a sealed case. We asked for ICA-based thin clients and NCs that comply with the NC specification; both types had to have Ethernet connectivity and 14-inch monitors.

We received Net PCs from Acer America, Advanced Modular Solutions, Compaq Computer Corp., Dell Computer Corp., Gateway 2000, Hewlett-Packard Co., and Sherwood Network Division. We also received systems configured as Windows terminals, but we found some of these units could be modified to be NCs or augmented *thin clients* (basically, systems that do little or no local processing); therefore we have classified them as thin clients. We tested thin clients from Boundless Technologies, Neoware Systems, Tektronix, and Wyse Technology.

We did not receive fully functional JDK 1.1–compliant NCs from any of the vendors we contacted. JDK 1.1, the latest Java developer standard, adds security features including code-signing, printing support, and support for development tools such as JavaBeans. Neoware chose to send a thin client (though the unit can be turned into an NC). Network Computer Inc. (NCI) did send us an NC, but the unit did not have a JDK 1.1–compliant browser, and we were unable to test it with our JavaMark 2.0 test suite. Tektronix and Sherwood sent NCs, but neither was JDK 1.1–compliant. We discuss those machines within each company's review. Network Computing Devices, IBM, and Sun Microsystems did not participate. (For more information, see "Network Computers: Finally Real?")

IN THIS REVIEW

Acer America Corp. 219
Advanced Modular Solutions Inc. 224
Boundless Technologies Inc. 218
Compaq Computer Corp. 224
Dell Computer Corp. 224
Gateway 2000 Inc. 228
Hewlett-Packard Co. 229
Neoware Systems Inc. 218
Sherwood Network Division 229
Tektronix Inc. 219
Wyse Technology 219

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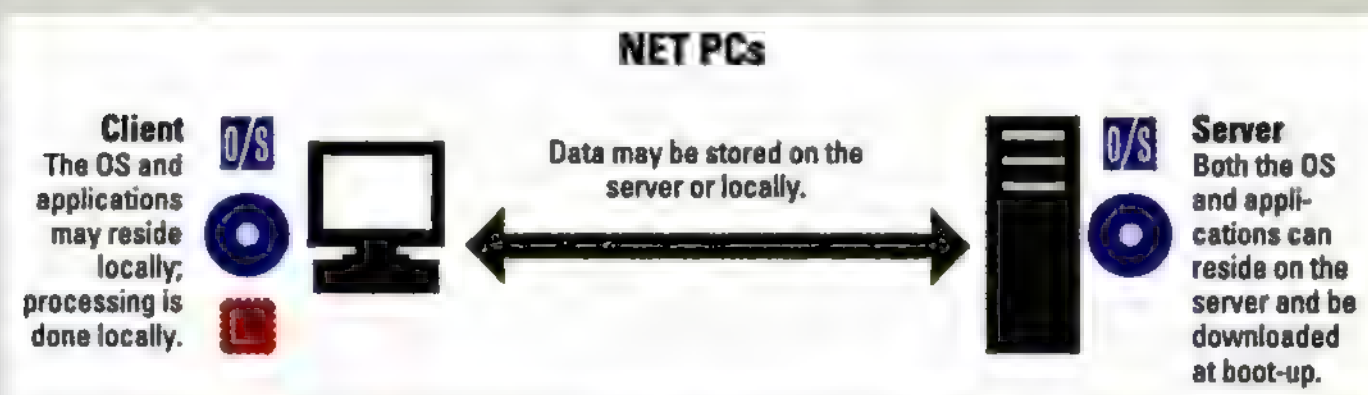
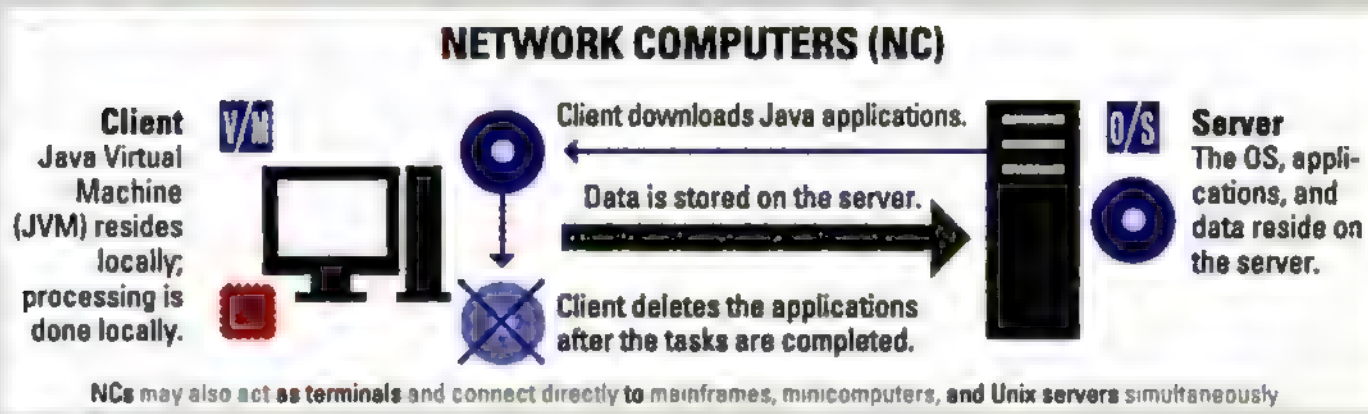
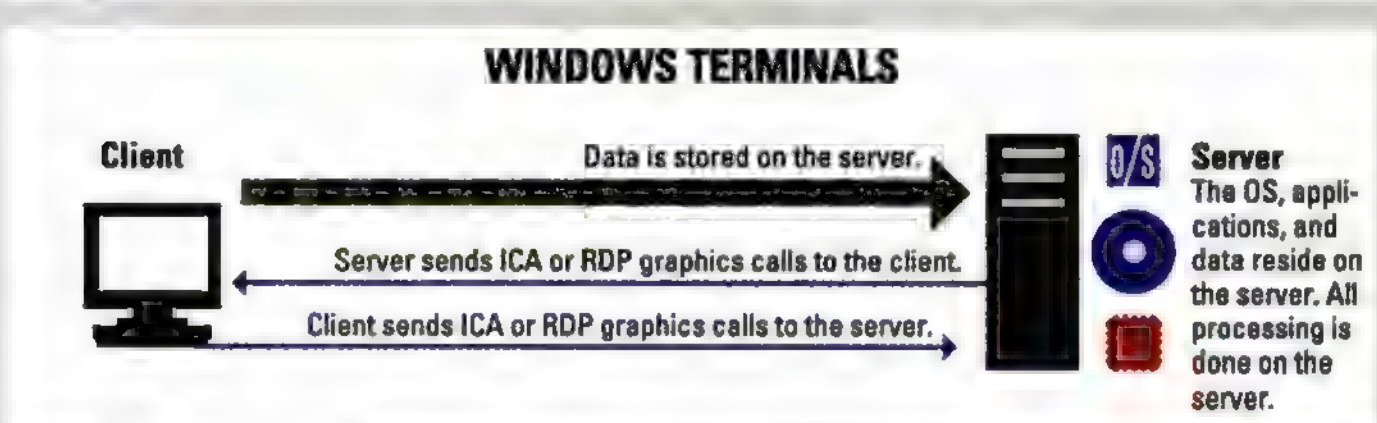
Division of Labor







THE THREE CAMPS

Managed PCs are standard PCs that comply with DMI 2.0 and come with desktop management software. *Net PCs* are supposed to be lower-powered cousins of managed PCs, optionally with sealed cases and perhaps distributed computing, in which applications and data reside off the client but processing occurs locally. Management applications that distribute and update client software over the network and let you restrict access to local system files and other files further reduce TCO.

Though primarily a Windows-camp response to the Java-based NC specification, Net PCs do offer advantages. They're meant for a more limited computing environment than managed PCs, so Net PCs get away with less powerful hardware, lowering the initial purchase price. The lack of CD-ROM and floppy disk drives prevents users from installing software. Offering hard disks and other traditional PC resources, Net PCs may pose the path of least resistance to PC users faced with alternative devices. And proponents note that since Net PCs are not completely server-dependent, they can operate independently in case the network goes down.

Because data (though not always applications) resides on the network, this advantage may be more hope than fact. Also, despite sealed cases and DMI, Net PCs do not offer the same level of security or centralized management that thin clients do, nor are they as easy to set up and maintain.

Windows terminals are thin clients that display graphics and do no local processing. They hook up to a Windows NT 3.51

Editors' Choice

- Net PC: HP Net Vectra
- Thin client: Neoware @workStation Supra-66

Our Editors' Choice Net PC, the $1,210 HP Net Vectra, offers top-notch management features. The thin-client Editors' Choice winner, the $950 Neoware @workStation Supra-66, provides great flexibility and security for centralized computing environments.

The HP Net Vectra is not a performance leader. But management features take precedence in a corporate environment, and that's where the Net Vectra excels. This Pentium MMX/166–based system comes with HP's TopTools 2.6, one of the best management software packages available. It allows complete inventorying of components, both local and remote, as well as remote BIOS updates, remote locking of components such as the floppy disk drive, and hardware monitoring of voltage. The unit supports Wake on LAN and remote power-on.

Just before we went to press we learned that this unit was replaced by 200-MHz and 233-MHz Pentium MMX–based models that offer all of the above management features.

The Neoware @workStation Supra-66 represents a new hybrid, which the company calls a *universal thin client*. You can configure the unit as a Windows terminal or as a flexible NC that can connect directly to platforms such as mainframes, Unix servers, and Windows NT servers and allow simultaneous access to applications on them. The @workStation Supra-66 is JDK 1.1–compliant when configured as an NC.

The system includes custom software, netOS, stored on a local disk. The software comes in three varieties: netOS for Intranets is the most advanced, allowing access to diverse platforms; netOS for WinTerminals turns the system into a standard ICA terminal; and netOS for the Enterprise lets the unit connect to mainframe servers.

The Compaq Deskpro 4000N ($1,350, with 15-inch monitor) and the Wyse Winterm 2510SE ($900, with integrated 14-inch monitor) both earn honorable mentions. The Compaq system is a terrific Net PC, and Compaq's Insight Manager offers many of the same features as HP's Top Tools. The Winterm 2510SE doesn't have the Neoware system's flexibility, but it is a great Windows terminal: It offers top-notch security features and diverse multiuser configurations.

server running Citrix WinFrame to allow multiuser connections to Windows applications on the server.

Windows terminals are cheap, offer the highest level of security, and often can be set up quickly. Most of the units we received were up and running within 10 minutes. With few moving parts (or none), they also have longer mean times between failures (MTBF) than Net PCs. Drives, such as hard disks and CD-ROM drives, are the most likely components to fail.

Because all processing is server-based, if the server goes down, so do all your users. "Hot backup" servers help prevent actual downtime and are recommended for any thin client network. But you'll have to meet the demand for primary servers first: Citrix Systems recommends a server CPU for every 15 to 25 clients, with plenty of memory to go around—a minimum of 8MB per user. Those servers add to capital and maintenance costs. Also, decreasing network traffic by enabling ICA compression lowers the client's performance, because it has to decompress the data. As our testing found, additional client features such as sound also diminish performance.

Like Windows terminals, the Java-based *NCs* are basically thin clients. NCs take over processing duties from the server, however, though no data or applications reside locally.

On paper, although not in practice, NCs seem like the best compromise between Windows terminals and Net PCs; Java's architectural neutrality adds to their appeal. NCs are inexpensive and offer some of the same security benefits as Windows terminals. And because applets are downloaded to the client and processed locally, NCs are not as network-dependent as Windows terminals. But NCs have been slow to market—only now are we beginning to see real units—and Java business applications just aren't here yet. That means you have to develop your own, and that will cost you.

BLURRED LINES

The differences among managed PCs, Net PCs, Windows terminals, and NCs are not as clearly delineated as theory suggests. Vendors typically market Net PCs as the low end of their managed PC lines, though the machines often come in sealed cases. Applications almost always reside locally (Advanced Modular Solutions' systems are an exception). That may change if Windows NT 5.0 offers the widespread support necessary for distributed computing in the PC space, but it is unclear whether Microsoft still plans to include this support (called Intellimirror) as a standard part of Windows NT 5.0.

Windows terminals and NCs were also supposed to be as distinct as Windows and Java. But hardware differences are minimal, and vendors have found that with a firmware change, they can sell the same

Our Contributors: TAMI D. PETERSON is a Ziff-Davis consumer reporter and columnist. ROBERT S. ANTHONY is a senior writer at *PC Magazine* and FRANK J. EVANS is a technical consultant and frequent contributor. ANUSH YEGYAZARIAN was the associate editor in charge of this story, and RICHARD FISCO was the project leader.

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SUMMARY OF FEATURES

Networked Computers

■ YES ▲ NO □ OPTIONAL

Price of tested configuration For systems sold through resellers, assume that street prices are 15 to 20 percent below list. Some vendors factor this discount into their quoted prices; in such cases, we indicate that the price cited is *street*. Street prices are rounded to the nearest $10. Some vendors sell directly to customers; such prices are listed as *direct* and are not discounted. All systems include monitors except the Wyse Winterm 2310SE.

Hard disk interface *Fast ATA-2* drives support up to PIO mode 4 and multiword DMA mode 2 and have a maximum burst transfer rate of 16.7 MBps. *Ultra ATA* drives comply with the Ultra DMA specification, which supports a burst throughput of 33.3 MBps. Windows terminals typically do not have hard disks.

MPEG-1 support Don't expect MPEG-2 video in these devices. MPEG-1 support allows you to read MPEG-1 clips, which offer better viewing quality than AVI clips.

Floppy disk drive/CD ROM drive Most systems in these classes come in cases with sealed front bezels but may offer both floppy disk and CD-ROM drives as options. Where these items are optional, we specify list prices.

Flash memory Developed by Intel, flash memory takes up little space and doesn't need continuous power to hold its memory (unlike DRAM, for example). Flash memory can be reprogrammed.

Smart card A credit card–size smart card holds memory, a processor, and a battery. Designed so that there is no physical contact between the card and the device that reads it, a smart card avoids traditional wear and tear.

Remote management implemented Some systems were not set up to monitor physical characteristics, such as temperature, and system assets, such as type of processor, remotely.

Boot protocols supported Common protocols include *IBM RIPL* (Remote Initial Program Load), used with an IBM Workspace-On-Demand server; *NFS* (network file system), a Unix networking protocol; *DHCP* (Dynamic Host Configuration Protocol), used for assigning dynamic IP addresses to network devices; *TFTP* (Trivial File Transfer Protocol), a version of the TCP/IP FTP protocol with no directory or password capability; *RARP* (Reverse Address Resolution Protocol), used by diskless workstations to obtain their logical IP addresses; and *BootP* (Bootstrap Protocol), which enables a diskless workstation to discover IP addresses for itself or for a BootP server on the network and to find a file to load into memory for booting.

All systems support printers.

	AcerPower Flex T4000 Net PC	Advanced Modular AX	Boundless Viewpoint TC Model 200	Compaq Deskpro 4000N
Category	Net PC	Net PC	Windows terminal	Net PC
Price of tested configuration	$1,150 street	$1,665 direct	$850 street	$1,350 street
System				
Processor	Pentium MMX/233	Pentium MMX/233	AMD 5x86/133	Pentium MMX/200
Installed external RAM cache and type	512K pipelined-burst	512K pipelined-burst	None	256K pipelined-burst
RAM type	SDRAM	Fast-page-mode DRAM	EDO DRAM	SDRAM
Installed/maximum RAM	32MB / 256MB	32MB / 64MB	4MB / 64MB	32MB / 256MB
Hard disk (interface)	4.1GB Maxtor 84320D4 (Ultra ATA)	1GB Hitachi DK223A-11 (Fast ATA-2)	N/A	1.5GB Seagate ST31721A (Fast ATA-2)
Graphics adapter (interface)	Integrated 3D Rage II +DVD (PCI)	Integrated Chips and Technologies F65550 (PCI)	Integrated Cirrus Logic CL-GD5446 (PCI)	Integrated S3 Trio 64V2/GX (PCI)
Memory size and type	2MB SGRAM	2MB EDO DRAM	1MB VRAM	2MB SGRAM
Motherboard manufacturer	Acer	Modular	Boundless	Compaq
Chip set	Ali IV, M1531	Intel 430HX	Acer Ali Finali M1489, M1487	AMD 640
BIOS manufacturer and version (or date)	Acer 3.0	AMI 1.07	Phoenix 4.05	Compaq (12/23/97)
Monitor (diagonal size, in inches)	Acer Acerview 56C (13.8)	Sampo KM-411 (13.5)	ADDS 3401 (13.5)	Compaq P50 (13.8)
Maximum resolution	1,600 x 1,200	1,024 x 768	1,280 x 1,024	1,280 x 1,024
Color support at maximum resolution	8-bit	16-bit	8-bit	8-bit
MPEG-1 support	■	[illegible]	[illegible]	■
Media and Sound				
Floppy disk drive/CD-ROM drive	□ ($34) □ ($91)	[illegible]	[illegible]	[illegible]
Flash memory	None	None	4MB	None
Smart card capability	[illegible]	[illegible]	[illegible]	[illegible]
PC Card capability	[illegible]	[illegible]	[illegible]	[illegible]
Audio	16-bit	None	None	None
Networking, Communications, and Management Features				
Network adapter (speed)	Integrated Intel EtherExpress Pro/100B (10/100 Mbps)	Digital 2140 (10/100 Mbps)	UMC 9008 10Base-T (10 Mbps)	Compaq Netelligent TX (10/100 Mbps)
DMI 2.0–compliant hardware	■	[illegible]	[illegible]	■
Remote management implemented	■	[illegible]	■	■
Desktop management software	Intel LANDesk 3.0	None	N/A	Compaq Insight Personal 1.09A
Boot protocols supported	BootP, DHCP, LSA, PXE, RP, RPL	BootP, DHCP, IBM RIPL, Microsoft RP, Novell RPL	BootP, DHCP	BootP, DHCP, TFTP
Expansion-bus slots	1 PCI, 1 PCI/ISA	None	1PCI, 1 ISA	1 PCI
Drive bays (5.25" / 3.5")	1 / 2	None	0 / 2	0 / 1
Power supply	75W	50W	180W	76W
Parallel/serial/mouse ports	1 / 1 / 1	1 / 1 / 1	1 / 2 / 1	1 / 2 / 1
USB/video ports	2 / 1	0 / 1	0 / 1	2 / 1
Service and Support				
Standard warranty on parts/labor	3 years/3 years	1 year/1 year	3 years/3 years	3 years/1 year
24-hour, 7-day toll-free technical support	■	[illegible]	[illegible]	■
One-year on-site service	■	[illegible]	[illegible]	■
24-hour parts turnaround	■	[illegible]	[illegible]	[illegible]

N/A—Not applicable: A Windows terminal does not come with a hard disk or desktop management software.

Networked Computers

See www.pcmag.com for interactive views

	Dell OptiPlex N	Gateway 2000 E-1000N 233	HP Net Vectra	Neoware @workStation Supra-66	Sherwood Passport	Tektronix ThinStream 215	Wyse Winterm 2510SE	Wyse Winterm 2310SE
	Net PC	Net PC	Net PC	Windows terminal/ network computer	Net PC	Windows terminal	Windows terminal	Windows terminal
	$1,311 direct	$1,118 direct	$1,210 street	$950 street	$1,080 street	$1,490 street	$900 street	$730 street[1]
	Pentium MMX/200	Pentium MMX/233	Pentium MMX/166	Intel 80960 RISC/66	Pentium MMX/166	NEC R4300/100	AMD SC400 486/66	AMD SC400 486/66
	512K pipelined-burst	256K pipelined-burst	256K pipelined-burst	None	512K pipelined-burst	None	None	None
	SDRAM	SDRAM	SDRAM	DRAM	DRAM	SDRAM	EDO DRAM	EDO DRAM
	32MB / 256MB	32MB / 256MB	32MB / 192MB	32MB / 132MB	32MB / 256MB	24MB / 40MB	8MB / 8MB	8MB / 8MB
	2GB Maxtor 82160D2 (Ultra ATA)	2GB Western Digital Caviar 12100 (Ultra ATA)	1.5GB Quantum Fireball ST16A101 (Ultra ATA)	1GB Quantum Pioneer (Fast ATA-2)	2GB Seagate ST52520A (Fast ATA-2)	N/A	N/A	N/A
	Integrated S3 Trio 64V2/GX (PCI)	Integrated S3 Trio 64V2/DX (PCI)	Integrated S3 Trio 64V2/DX (PCI)	Custom ASIC	Integrated S3 Trio 64V2/DX (PCI)	Integrated Cirrus Logic CL-GD5465 (PCI)	Integrated Cirrus Logic CL-6D5440 (VL-Bus)	Integrated Cirrus Logic CL-6D5440 (VL-Bus)
	2MB EDO DRAM	2MB SGRAM	2MB EDO DRAM	2MB VRAM	1MB SDRAM	2MB RDRAM	1MB DRAM	2MB DRAM
	Dell	Solectron	HP	Neoware Systems	EFA	Tektronix	Wyse	Wyse
	Intel 430TX	Intel 430TX	SIS 5581	Custom ASIC	VIA 580VPX	NEC R4300	VIA VT82C42	VIA VT82C42
	Dell/Phoenix A06	AMI 0AA6T03A	Phoenix/HP HE.01.03	Neoware 3.1	Award 4.5.1PG	Tektronix 7.0	Wyse 2.04	Wyse 2.64J3
	Dell 800LS (13.8)	Gateway EV500 (14.0)	Hewlett-Packard 1024LE (14.0)	Hyundai HL5870A (13.7)	ViewSonic OptiQuest V641-1M (13.8)	Tektronix TX-T5F65 (14.0)	Integrated (14.0)	Not included
	1,280 x 1,024	1,280 x 1,024	1,600 x 1,200	1,600 x 1,200	1,280 x 1,024	1,024 x 768	800 x 600	1,024 x 768
	8-bit	8-bit	8-bit	8-bit	16-bit	8-bit	8-bit	8-bit
	■	■	■	■	■	■	■	■
	■ ■	■ ■	■ ■	☐ ($79) ■	■ ■	☐ ($250) ■	■ ■	■ ■
	None	None	192K	☐ (8MB, $200)	☐ (2MB–12MB, $30–$180)	☐ (2MB–12MB, $99–$595)	4MB	4MB
	■	■	■	■	■	■	■	■
	■	■	■	■	■	■	■	■
	None	16-bit	None	☐ (16-bit, $90)	16-bit	16-bit	None	None
	Intel EtherExpress Pro/100B (10/100 Mbps)	AMD AM79C971 (10/100 Mbps)	HP NightDirector 10/100BT LAN Interface (10/100 Mbps)	Intel 82596 10Base-T (10 Mbps)	Intel 82558 (10/100Mbps)	Custom integrated AMD (10/100 Mbps)	Integrated Crystal LAN CS8900 (10 Mbps)	Integrated Crystal LAN CS8900 (10 Mbps)
	■	■	■	■	■	■	■	■
	■	■	■	■	■	■	■	■
	Dell Inspector 4.1	Intel LANDesk 3.1	HP Toptools 2.6	N/A	Sherwood Zero Administration Toolkit	N/A[2]	N/A	N/A
	DHCP, LSA, PXE	BootP, DHCP, LSA, PXE, RP, RPL, TCP/IP, TFTP	BootP, DHCP, RARP, TFTP	BootP, DHCP, RARP	BootP, DHCP, IPX, RARP, RPL	BootP, DHCP, NFS, RARP, TFTP	DHCP	DHCP
	1 PCI	2 PCI	2 PCI	None	None	None	None	None
	0 / 1	1 / 2	0 / 1	0 / 2	1 / 0	0 / 0	0 / 0	0 / 0
	80W	200W	80W	40W	65W	25W	20W	20W
	1 / 2 / 1	1 / 1 / 2	1 / 1 / 1	1 / 2 / 2	1 / 2 / 1	1 / 2 / 1	1 / 2 / 1	1 / 2 / 1
	2 / 1	2 / 1	2 / 1	0 / 1	0 / 1	0 / 1	0 / 0	0 / 1
	3 years/1 year	3 years/3 years	3 years/3 years	1 year/1 year	1 year/1 year	1 year/1 year	3 years/3 years	3 years/3 years
	■	■	■	■	■	☐ (cost varies)	■	■
	■	■	■	■	■	☐ ($145)	■	■
	■	■	☐ (3 years, $160)	☐ (1 year, $99)	■	☐ (1 year, $70)	☐ (1 year, $79)	☐ (1 year, $59)

(1) This price does not include a monitor. (2) This product does have remote-setup software.

box in either configuration—an appealing idea for those who want to hedge their bets.

Vendors such as IBM and Neoware go a step further. Each has an "NC" system that supports JDK 1.1, but both companies developed software that allows their systems to connect directly with mainframes, Unix servers, and Windows NT servers, presenting each environment as a window on the client. Strictly speaking, NCs are supposed to do this, but Java applets must enable the communication. Neoware and IBM claim to give you that functionality without the development costs.

COMES "HYDRA"

Microsoft's Windows Terminal Server (formerly code-named Hydra) will be making its debut in the Windows terminal market in the second half of this year. It will use MultiWin technology developed by Citrix, and it will support Citrix's forthcoming software (still code-named pICAsso), which will add long-awaited support for Windows NT 4.0. Microsoft's new software will also use a different protocol (Remote Display Protocol, or RDP), and Microsoft has plans to port a version of its operating system Windows CE for the client side of the equation. Windows CE will allow more devices to be hooked up to the network, and it's a smaller OS, which is easier for the client to deal with. Most Windows terminal vendors are ready, and their hardware will support the new software; ICA will exist concurrently.

SO WHICH MANAGEMENT SOLUTION?

To decrease support costs but still give users the flexibility and power they're used to with traditional PCs, your best bet is a managed PC. Whether that would be a true managed PC or a what is now called a Net PC depends on your users' needs. The Net PC is rapidly becoming distinguished merely by the type and size of its case. Despite talk about paradigm shifts, we expect this will be the best solution for most.

A thin client is a good choice for replacing older terminals, where security is a top concern and where users primarily run one application or need access to centralized data. We recommend the new "hybrid" thin clients for their flexibility to link simply, directly, and simultaneously to multiple server platforms. The software allowing that is still proprietary, however.

Thin Clients

Boundless Viewpoint TC Model 200

Expandability, ease of setup, and top performance mark Boundless's Windows terminal, the Viewpoint TC Model 200 ($1,230 street, with 15-inch monitor).

At 2.5 by 12.5 by 12 inches (HWD), the unit is larger than most of the others we tested, in part because the power supply is enclosed within the system. The size provides greater versatility, however: You can install a hard disk (you'll need to add a fan as well) and other network cards through a specialized ISA/PCI riser card.

The unit's graphical setup display is well

Boundless Viewpoint TC Model 200

designed, and embedded pull-down menus allow easy viewing of the setup configuration. Support personnel with little or no training could get this unit up and running in about 15 minutes. Another advantage: It's fairly easy to set up multiple accounts so that users can get to their pathway seamlessly; this is not the case with all Windows terminals. The system we tested came with a 10Base-T connection installed; other options include a $180 100Base-T version. No management software was included (Boundless sells its ViewPoint Administrator for an additional $295 per server); terminal emulator software is standard.

Though servers and network constraints play a significant part in Windows terminal performance, our testing found that local processors and firmware do matter. The TC Model 200's AMD 5x86 133-MHz CPU is the most powerful of those in the Windows terminals we reviewed, and it helped this unit earn top scores on both of our tests. The unit's result in the Excel test bettered the average by 20 seconds.

Technical support is available weekdays, 8:30 A.M. to 8:00 P.M. (eastern time). Boundless does not usually sell its systems with a monitor; you must request one.

Given its performance and expandability, corporate buyers should seriously consider this unit.—*Frank J. Evans*

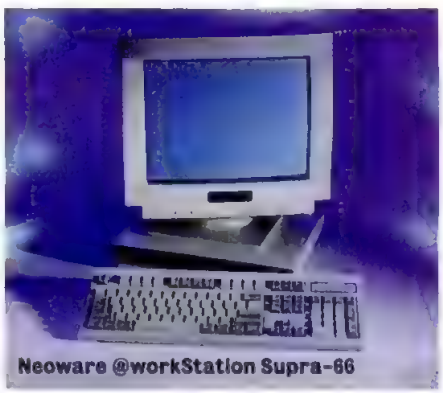
Boundless Viewpoint TC Model 200. Street price: $1,230. Boundless Technologies Inc., Hauppauge, NY; 800-231-5445, 516-342-7400; fax, 516-342-7378; www.boundless.com. *Choose 541 at www.pcmag.com/infolink.*

Neoware @workStation Supra-66

PC MAGAZINE EDITORS' CHOICE

Neoware Systems (formerly HDS Network Systems) markets its @workStation Supra-66 ($950 street, with a 14-inch monitor) as a universal thin client. Designed to go into almost any installation for use as a text terminal, as a Windows terminal, or even as an NC with a software change (units are currently JVM 1.1–compliant), the system earns our Editors' Choice.

The @workStation took the longest to boot up of the Windows terminals we tested and was the only one that came with its own hard disk. The disk is for netOS, the unit's proprietary software, not for storage. This software sets the system apart from it competitors and comes in three flavors. The most advanced form, netOS for Intranets ($75 list)—which we received—boots the system to a Windows-like screen that enables users to click on icons and connect to mainframe, Java, Windows, and browser applications. netOS for WinTerminals ($50 list) turns the system into a standard ICA terminal; and netOS for the


Neoware @workStation Supra-66

Enterprise ($65 list) lets the unit connect to mainframe servers. All versions include server software that lets administrators update local clients remotely.

Both Microsoft and Sun keyboard ports are included with the unit, and the

power supply is built into the case, which has the largest footprint of the products we reviewed. For on-board audio, add $50 (street); an internal or external floppy disk drive is $50 (street).

The unit earned strong scores on our tests. The product offers a one year warranty; additional years cost $29 per year. Technical support is available weekdays from 8:00 to 8:00. Windows CE will ship with the unit when it becomes available.

The @workStation's versatility and software make this an appealing choice for any network manager.—*FJE*

Neoware @workStation Supra-66. List price: $1,142. Neoware Systems Inc., King of Prussia, PA; 800-636-9273, 610-277-8300; fax, 610-275-5739; www.neoware.com. *Choose 542 at www.pcmag.com/infolink.*

Tektronix ThinStream 215

Tektronix's ThinStream 215 ($1,490 street, with a 15-inch monitor) is a modular Windows terminal: Sound, PC Cards, a floppy disk drive, and faster network connections are optional components. Our unit had sound, extra memory, and 100-Mbps Ethernet; the base price without these options is $1,200. The unit was not the fastest system we tested nor the easiest to set up, but it has some appealing features.

Tektronix markets a unit very similar to the one we tested as an NC; the major difference is in firmware. The NC is now JDK 1.02–compliant; a JDK 1.1–compliant version should be available later this year. Windows CE models will also be supported.

Tektronix ThinStream 215

The unit came with the most complete documentation of any system. It was also the most complicated to set up, because of its enigmatic DOS-like commands. Tektronix says its systems are usually set up prior to shipping, but administrators with custom configurations will have to learn Tektronix's command set. Typing *help* displays some but not all commands.

The system uses an X-derivative code in parallel with regular ICA protocol for display, allowing regular images and video to display at 30 frames per second. This unit was the only Windows terminal we saw that could do this, but we see benefits for only a narrow set of users.

This parallel protocol processing is seamless to users but hurts performance. The ThinStream was slower than average on both of our tests. Performance was also affected by the fact that the unit's sound was enabled. (Sound calls are sent over the network and take up space in memory.) Tektronix also claims additional memory (our unit had 24MB; 8MB is standard on-board) lowers performance, since the integrated memory has a faster access time.

We liked the unit's small footprint but not its bulky external power brick. Tektronix will replace defective units within one year of purchase.

The unit's modularity is attractive, but setup is not as easy as for most others.—*FJE*

Tektronix ThinStream 215. Street price: $1,490. Tektronix Inc., Beaverton, OR; 800-547-8949, 503-627-7111; www.tek.com/vnd. *Choose 543 at www.pcmag.com/infolink.*

Wyse Winterm 2510SE, 2310SE

Wyse Technology has the broadest product line of all the thin-client manufacturers. We tested two systems, the Winterm 2510SE ($900 street), an all-in-one monitor and CPU system, and the Winterm 2310SE ($730 street, sold without monitor), a more standard Windows terminal. The company's well-thought-out products and service offerings make either system a good choice.

Both units target corporations that already have terminals and are looking to upgrade to clients that can run mainframe applications (through the Citrix server connection), Windows applications, or both. The Winterm 2510SE is also Wyse's low-cost solution for departments that are just now moving to computers.

Setting up either Wyse terminal is a snap. The systems can also be very easily set up for single or multiple users running a variety of applications; setup configurations are stored on the server. The firmware on individual systems can be upgraded easily via a flash memory update; simultaneous multiple-terminal updates can also be handled from the server through WyseWorks Remote Administrator Server software. Both systems have a Type II PC Card slot, and upgrading to

Wyse Winterm 2310SE

100Base-T is an option, but all additional components, by design, remain external.

Despite housing the CPU, the Winterm 2510SE is not noticeably larger than a typical monitor. All ports appear on the back of the unit, and a large power switch is clearly visible on the front. The unit does not run at 1,024-by-768 resolution but at 800-by-600, and it comes with 1MB of graphics RAM.

The sleek Winterm 2310SE has the smallest footprint of any unit in this roundup, at 10 by 4 by 7 inches. We have one complaint: The power button is sensitive and improperly placed, making it easy to turn the unit on or off unintentionally.

Windows CE will be supported when available. Telephone technical support is available weekdays from 3:30 A.M. to 1:30 P.M. (eastern time).

Both units garnered respectable scores on our tests, and both are excellent Windows terminals.—*FJE*

Wyse Winterm 2510SE. Street price: $900.
Wyse Winterm 2310SE. Street price: $730.
Wyse Technology, San Jose, CA; 800-438-9973, 408-473-1200; www.wyse.com. *Choose 544 at www.pcmag.com/infolink.*

Net PCs

AcerPower Flex T4000 Net PC

With a component list that reads more like that of a mainstream PC than a Net PC, Acer America's AcerPower Flex T4000 Net PC ($1,150 street) offers terrific performance and the manageability features needed in a networked corporate setting.

Technology is a race. Presenting the Official Pace Car.

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BENCHMARK TESTS

Networked Computers

For those who need top performance, the Boundless Viewpoint TC Model 200 was the best thin client. In the Net PC camp, the leader was the Acer-Power Flex T4000 Net PC.

What the Numbers Mean

Performance isn't key in this category—manageability is. Overall, though, based on the target market, Net PCs are usually faster and more powerful than thin clients.

Because thin clients and Net PCs can't be fairly compared, we tailored tests to each group. Net PCs are basically PCs that are well managed and restrict outside file access and user modifications to the system. Because they are PCs, we were able to run our standard suite of benchmark tests. Graphics capabilities are key to thin clients, because they do no local processing, only screen updates; accordingly, PC Magazine Labs developed Microsoft Word and Excel macro tests that isolate and stress the units' graphics capabilities.

Net PCs ZD Business Winstone 98 The Acer machine came to us more heavily loaded than any other system. It used the fastest processor in this roundup, a Pentium MMX/233; the largest and fastest hard disk, a 4.1GB Ultra ATA 5,200-rpm Maxtor model; and a top-performing 2-D and 3-D accelerator, the ATI 3D Rage II+DVD. With those specifications, it's no wonder the unit was the best Winstone performer. Most of the other systems used either a 200-MHz or 166-MHz Pentium MMX processor and slightly slower S3 graphics chip sets.

The Advanced Modular AX performed poorly despite using the same CPU as the Acer unit. The Modular AX was hampered by a slow-spinning Hitachi disk and an underachieving graphics chip, the Chips and Technologies F65550.

ZD Business Graphics WinMark 98 Most of the systems here came with graphics chip sets that we haven't seen in desktop PCs in more than two years. The Chips and Technologies and S3 chips found in most of the systems provide only basic graphics capabilities. Although they are reasonable 2-D performers, they are not speed demons and incorporate no 3-D acceleration. In stark contrast, the AcerPower Flex T4000 Net PC came with a modern powerhouse graphics chip set that easily bested the competition in a match that would best be described as unfair. The ATI 3D Rage II+DVD helped the Acer unit score more than 23 percent higher than its next-closest competitor. In addition, the Rage II supports 3-D acceleration. Though a nice feature, 3-D capability is not something we believe buyers look for in a Net PC, and we did not test this capability.

The Modular AX again had the lowest score, thanks to its Chips and Technologies 65550 graphics chip set. Compared with the S3 Trio64/V2 that most others used, the 65550 is practically ancient, and the scores reflect that: The Modular AX's result was only one quarter that of the top-scoring Acer system.

The Sherwood Passport came with only 1MB of graphics memory; we tested it at 800-by-600 resolution and 16-bit color. Despite running at this lower resolution, the Sherwood unit, with an S3 Trio64V2/DX graphics chip set, still produced a low score. We performed some informal testing of other Net PCs at the same resolution for comparison; the Sherwood system still scored 30 to 55 percent below the others. The unit used an older driver, which we suspect is less optimized and contributed to the lower score.

ZD Business Disk WinMark 98 Although this class of systems is not performance-driven, new Ultra ATA disks were prevalent. Naturally, systems that used Ultra ATA disks—from Acer, Dell, Gateway and HP—earned the top scores. Once again, the Acer unit scored highest. The combination of its top-performing processor and memory and the Ultra ATA disk gave it the edge.

Once again, the Modular AX had the lowest score. The unit's Hitachi hard disk is made for use in portable PCs, in which disks that spin at 5,000 rpm or faster are rare. The Hitachi DK223A-11 spins at a relatively slow 4,464 rpm.

ZD CPUmark$_{32}$ As expected, the systems with the fastest processor—in this roundup, the Pentium MMX/233—garnered the top scores. The Acer unit beat the rest of the pack by about 6 percent by combining the 233-MHz CPU with SDRAM and 512K of L2 cache. L2 cache sizes in the various systems also affected scores. The Acer and Gateway Net PCs had the same processor, but the Acer unit had 512K of L2 cache compared with the Gateway system's 256K. Similarly, both the Dell and Compaq systems used a Pentium MMX/200 CPU, but the Dell unit, with 512K of L2 cache, edged out the Compaq system, with 256K. In both cases, the additional L2 cache led to about a 6 percent increase in CPUMark$_{32}$ scores.

Although the Modular AX had the same

NET PCs

Bold type denotes first place.

	ZD Business Winstone 98 Score	ZD Business Graphics WinMark 98 Score	ZD Business Disk WinMark 98 Thousands of bytes per second	ZD CPUmark$_{32}$ Score
AcerPower Flex T4000 Net PC	**18.3**	**80**	**1,455**	**400**
Advanced Modular AX	9.9	20	575	396
Compaq Deskpro 4000N	14.9	54	989	385
Dell OptiPlex N	16.4	62	1,305	406
Gateway 2000 E-1000N 233	17.0	65	1,420	434
HP Net Vectra	15.1	58	1,255	380
Sherwood Passport*	12.4	39	1,235	351
	BETTER ▶	BETTER ▶	BETTER ▶	BETTER ▶

* We tested this system at 800-by-600 resolution, the highest it could handle

233-MHz processor as the Acer system, the Modular AX's score was 16 percent lower. The Modular AX's use of standard DRAM and not SDRAM as in the Acer unit is the principal reason for this disparity.

Thin Clients The strongest performance came from the Boundless terminal. Although both its AMD 5x86/133 processor and its 2-D–only Cirrus Logic CL-GD5446 graphics chip set are outdated by PC standards, they are more than sufficient to do their usual tasks and earned the unit first place on both our Microsoft Excel and Word tests. The faster processor in the Boundless system especially helped it outperform the other terminals.

Both Wyse units used the same motherboard and components, but the Wyse Winterm 2510SE monoputer outperformed the Winterm 2310SE, shaving a few seconds off its sibling's timing on our Excel test. That's because we tested the Winterm 2310SE at 1,024-by-768 resolution, the same as the other Windows terminals, but we ran the Winterm 2510SE at 800-by-600, the maximum resolution the unit's firmware supports. At the lower resolution, the Winterm 2510SE posted a better score.

How We Tested

We connected each system to a Dell Poweredge 2200 server via a 10Base-T HP J2610A AdvanceStack Hub. The Poweredge server is a dual-Pentium II/233 system with 512K of L2 cache, 128MB of RAM, an ATI 264VT2 graphics card with 1MB of memory, an Adaptec 7880 SCSI card controlling a 4GB Western Digital Enterprise 4360 hard disk, and an NEC 464 CD-ROM drive, running Microsoft Windows NT 3.51.

The Net PCs came loaded with Windows NT 4.0 Workstation and DMI 2.0–compliant client software. We connected the Net PCs to the server, downloaded the benchmark programs, and ran the tests. Because these systems don't have much graphics memory, we ran the tests in 1,024-by-768 resolution and 16-bit color. (Two of the units had to be set to lower resolutions.) We tested the thin clients using Microsoft Excel and Word macros created by PC Magazine Labs.

ZD Winstone 98 is divided into two parts: **ZD Business Winstone 98** and **ZD High-End Winstone 98**. We ran only our Business Winstone 98 tests, which measure the time a PC takes to execute a set of nine application scripts, on all Net PCs. The tests weight each PC's timings based on the applications' unit market shares, derive a composite number, and convert that number to a relative score. (The score is relative to the performance of a Dell Dimension Pentium/133 with 32MB of RAM at 1,024-by-768 resolution with 16-bit color. The base score is defined as 10.)

ZD WinBench 98 measures a system's graphics, disk, and processor performance. Like our Winstone test program, **ZD Graphics WinMark 98** and **ZD Disk WinMark 98** are divided into business and high-end sections; we ran only the business portions. The **Business Graphics WinMark 98** score is based on a log of GDI operations used in Business Winstone 98. Scores are normalized to the base system used for Winstone testing. The **ZD Business Disk WinMark 98** score is based on a log of disk functions used in the Business Winstone 98 suite. We record the results in thousands of bytes per second and convert them to a harmonic mean. We then weight this mean in the same way as the Business Winstone 98 score. **CPUmark$_{32}$** emulates the CPU activity of real-world 32-bit applications. We ran the Winbench tests only on the Net PCs.

We connected the thin clients to the server using the ICA protocol of Citrix Winframe 1.7. We also applied Hotfix 37 (se170037) to the systems. We installed Citrix Winframe 1.7 on top of Windows NT server 3.51 as required by Citrix. We then ran timed **Microsoft Excel and Word macros**. The macro tests were developed and run using Microsoft Office 97, Professional Edition. The macros emulate common tasks used in both programs while emphasizing graphics functions. Tasks that rely heavily on disk activity are minimized. There were no printing tasks. We ran the macros three times and timed them by hand. Our printed results are the average of the three test runs.

THIN CLIENTS

Bold type denotes first place.

	Microsoft Excel Seconds	Microsoft Word Seconds
Boundless Viewpoint TC Model 200	**49**	**48**
Neoware @workStation Supra-66	52	51
Tektronix ThinStream 215	112	58
Wyse Winterm 2510SE*	61	57
Wyse Winterm 2310SE	65	58

◄ BETTER ◄ BETTER

* We tested this system at 800-by-600 resolution, the highest it could handle

It's no accident that this unit is configured like a mainstream PC: That's exactly how Acer designed this series of convertible corporate units. Acer offers bezel kits that let you transform a Flex T4000 managed PC into a Net PC and vice versa. The unit's case is taller than most Net PCs in this roundup, but its footprint is smaller.

The lockable cover is secured with three thumbscrews; there is no intrusion alarm. A two-piece cage holding the drive bays and a riser card with two PCI slots and an ISA slot is held down with just one screw. But the power supply must be removed to access the motherboard's drive connectors.

AcerPower Flex T4000 Net PC

In addition to a Pentium MMX/233 CPU, the motherboard integrates ATI's 3D Rage II+DVD graphics chip set with 2MB of SGRAM—a rather robust solution for a Net PC. It also has a 10/100-Mbps Ethernet chip set, a 16-bit audio chip set, and two USB ports. The 4.1GB Maxtor hard disk is the largest-capacity drive in this roundup. The powerful graphics chip set and large hard disk helped the Flex T4000 to the roundup's highest test scores.

The unit was bundled with Intel LANDesk Client Manager software. Management features include Wake on LAN, DMI 2.0 compliance, CPU temperature, voltage and fan monitoring, and a SMART hard disk. Acer sells a complete client/server solution, which includes its Advanced Server Manager Pro software.

Powerful performance, interchangeable design, and a healthy warranty recommend this unit.—*Robert S. Anthony*

AcerPower Flex T4000 Net PC. Street price: $1,150. Acer America Corp., San Jose, CA; 800-733-2237, 408-432-6200; fax, 408-922-2933; www.acer.com/aac. *Choose 545 at www.pcmag.com/infolink.*

Advanced Modular AX

The most network-centric of the Net PCs we tested, and the thinnest, Advanced Modular Solutions' Modular AX ($1,665 direct) is meant for high-transaction tasks and situations where data security is a top concern; in that space, it should do well. The unit's thin 1GB hard disk is intended for use as a boot-up device and for limited local storage. Modular AX's default configuration has all data and applications on the server. The unit's high price —the highest in the roundup—is partly due to its 132MB of RAM and Pentium MMX/233 processor.

The Modular AX is designed to provide straightforward network connectivity. The little black box, about a third of the size of most Net PCs reviewed here, does not have drive bays, expansion slots, or an audio subsystem; the unit uses a large, notebooklike external 50-

Advanced Modular AX

watt power brick. The small, highly integrated motherboard holds a 10/100-Mbps Ethernet chip set and a 64-bit graphics chip set with 2MB of EDO DRAM.

Although this unit lacks some conventional software management attributes, it has features to facilitate network connection. With NetWare, Windows NT, OS/2, or Unix, the unit will automatically be detected and logged on. Under an OS/2 network, the unit can also boot from the network without a local hard disk.

The system's scores on our tests, far behind those of the other Net PCs, were hampered by its slow Hitachi hard disk and Chips and Technologies graphics chip set.

The company, founded in 1992, offers a line of homegrown modular corporate client-server solutions, complete with software and on-site training for setup and maintenance. Technical support is available weekdays during business hours.

Despite low performance, the unit's limited hardware and minimal local data storage make it a good solution for those requiring high-data security.—*RSA*

Advanced Modular AX. Direct price: $1,665. Advanced Modular Solutions Inc., Boxborough, MA; 800-266-3852, 978-266-9700; fax, 978-266-1601; www.mod.com. *Choose 546 at www.pcmag.com/infolink.*

Compaq Deskpro 4000N

The Compaq Deskpro 4000N doesn't fall far from the Deskpro family tree of manageable PCs, which is good news for users and support technicians. The unit's hard disk could not keep up with its competition on our tests, however. The unit costs $1,350 (street).

The Deskpro 4000N is basically a Deskpro 4000S without a CD-ROM or floppy disk drive—the units use the same lockable chassis. The cover slides off smoothly after you press two side buttons, and an easy-to-remove corner cage holds a lone PCI slot on a riser card. The spring-loaded drive-bay cage swings up and over to provide clear access to the slide-out motherboard.

These features are a boon for your IS technicians, and there is more: Compaq bundles its Insight Manager software. This software offers complete asset management, monitors temperature and fans, has remote alarms in case of parts damage or failure, can perform remote BIOS updates, and reports changes in memory configuration. The unit also has Wake on LAN and remote power-up capabilities. Compaq offers a choice of third-party network management applications, via its Management Solutions Partners Program, to aid in overall network management as well as tasks such as software distribution.

The motherboard integrates graphics, a 10/100 Ethernet adapter, and a connector for an optional 120MB floppy disk drive. A motherboard map is pasted

Compaq Deskpro 4000N

inside the unit's cover, and an extra fan directs air to the CPU's large heat sink.

The Pentium MMX/200–based unit scored consistently behind other Net PCs we tested. Its Business Disk WinMark 98 score was markedly below average, thanks to the disk's slow rotational speed and a less efficient AMD PCI chip set.

Compaq's system earns points for terrific management and serviceability.—*RSA*

Compaq Deskpro 4000N. Street price: $1,350. Compaq Computer Corp., Houston; 800-345-1518; fax, 281-518-1442; *www.compaq.com.*

Dell OptiPlex N

Ably holding its own as part of Dell's OptiPlex family of managed units, the Pentium MMX/200–based OptiPlex N Net PC ($1,222 direct) offers great serviceability and good management features as well as good performance. Because Dell also offers its Net PCs as part of a complete client/server solution, the company has chosen not to allow its Net PCs to be configured and ordered through its Web site.

Dell markets the OptiPlex N slimline desktop as a "chassis extension" of the OptiPlex line, all of which come in easy-to-service chassis. The unit offers the same DMI 2.0–compliant manageability features and uses many of the same components as Dell's Gn and Gn+ lines of Pentium MMX–based managed PCs. Dell also has the Pentium II–based NX series of Net PCs and GXa series of managed PCs.

Like other OptiPlex systems, the OptiPlex N has a Dell-engineered lockable case with a cover that swings off easily after two side buttons are pressed; there is no intrusion alert, though. A lever disengages a metal cage holding both the hard disk and riser card with a single PCI slot. The power supply is built across the front of the unit, allowing easy access to the motherboard.

The unit was configured with an Intel EtherExpress 10/100-Mbps Ethernet card that supports Wake on LAN. Dell Inspector 4.1, Dell's software management package, offers asset tracking and supports remote adapter and I/O locking. The unit's motherboard has no hardware monitoring capabilities. Dell also markets servers and bundles them with Intel LANDesk Configuration Manager for centralized client-software management.

The unit was an average performer for

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Dell Optiplex N

its class. Dell provides 24-hour, toll-free technical support.—*RSA*

Dell OptiPlex N. Direct price: $1,222. Dell Computer Corp., Round Rock, TX; 800-388-8542, 512-338-4400; www.dell .com. *Choose 548 at www.pcmag.com/ infolink.*

Gateway 2000 E-1000N 233

Gateway 2000, better known for its mail-order professional and enthusiast PCs, has engineered a good Net PC in its $1,019 (direct) Pentium MMX/233–based Gateway 2000 E-1000N 233. The unit has all of the hardware and manageability features necessary to be a capable managed system. Its performance on our tests was above average.

The slimline desktop unit fits neatly into Gateway's E series of network-ready corporate PCs. It uses the same hardware and chassis as the slimline E-1000 Pentium MMX managed PCs (but a different bezel). Gateway also offers the more expandable E-3000 line of Pentium MMX managed PCs and the E-3110 and E-5000 lines of Pentium II–based units.

A single thumbscrew secures the cover of the E-1000N to its chassis, which

Network Computers: Finally Real?

In August 1996, Apple, IBM, Netscape, Oracle, and Sun Microsystems introduced a new term to the PC marketplace: the NC, or network computer. This Java-based system promised to be architecturally neutral, easy to manage and use, and inexpensive, both at initial purchase and over the life of the system—advantages supposedly attractive enough to induce administrators to replace PCs. Though the term has remained more talk than fact, some products are beginning to emerge.

THE PLAYERS

Currently, there are four primary sources of NCs for those who want systems that comply with Java Development Kit (JDK) 1.1: IBM, Neoware, Network Computer (NCI), and Sun Microsystems. Other companies, such as Sherwood and Tektronix, offer units that comply only with JDK 1.02.

We recommend that you consider only JDK 1.1–compliant NCs. JDK 1.1 adds support for security features and more tools for developers. More efficient, less resource-intensive code translates into faster applications.

We contacted all parties to obtain JDK 1.1 units. Neoware chose to participate in the thin client section of this roundup. IBM declined: The company said its NetStations could be appropriately tested and positioned only in a multiserver and multiplatform environment. Sun also declined; that company's systems are not available in quantity.

NCI Network Computer

NCI sent us the **NCI Network Computer** ($1,024 direct, with a 15-inch monitor) from its alliance partner, Funai (*www .funaiusa.com*). The unit had a Pentium/133 processor, 512K of L2 cache, 32MB of DRAM, an S3 Trio64 graphics chip set with 2MB of memory, and 10Base-T Ethernet. The unit measures only 3 by 12.3 by 9.8 inches (HWD), and it has one ISA, one PCI, and one Smart Card slot.

To test the unit, we connected it to a Sun SPARCstation. Unfortunately, the JVM (Java Virtual Machine) in the unit's Netscape Navigator 3.0.1 browser does not support JDK 1.1. We increased the default-memory process size and tried to run our JavaMark 2.0 test through the bundled AppletViewer (necessary for running JDK 1.1 software in this unit), but it failed. (Network Computer Inc., Redwood Shores, CA; 888-345-4624; www.nc.com. *Choose 550 at www .pcmag.com/infolink.*)

THE ARGUMENT AND THE DETAILS

The idea behind NCs is a good one. Give users a Web- or Java-based graphical interface, with access to Java-based communications and productivity software, and enable local processing to decrease the server load—all while keeping the client thin, centrally managed, and inexpensive. Java's hardware platform independence is also a great plus. It sounds perfect, but as in all things, the devil is in the details.

NCs were supposed to cost less than PCs, but falling PC prices are rapidly nullifying this advantage. And installing multiple clients and the servers to run NCs is still far from a simple process. The NC platform as a whole remains easier to manage than PCs, however.

NCs have been slow to market, and there is a lack of Java-based traditional business-productivity applications for them. Corel has scaled down its plans for a full office suite. Lotus Corp.'s eagerly awaited E-Suite and Star Division's StarOffice for Java are still in beta.

To make up for the lack, IBM and Neoware have written their own code to let their NCs connect directly and simultaneously to mainframes, Unix servers, and the like now, without requiring Java applications (both systems also run Java).

The future of NCs is unclear. Despite their aim to be PC replacements, they have evolved mostly into terminal replacements, in kiosks or points of sale and in intranet/internet devices.—*Frank J. Evans*

includes an intrusion detector but no lock. A gentle pull on a key ring releases the hard disk cage, which swings up and out of the way to provide access to the motherboard's two DIMM slots. The power supply runs the length of the right side of the chassis, out of the way of the motherboard.

The unit comes with Intel LANDesk Client Manager software and has Wake on LAN support. Features integrated on the motherboard include a 10/100-Mbps Ethernet chip set, a 16-bit audio subsystem, an LM78 system-monitoring chip, and an S3 Trio 64V2/DX graphics chip set. Two PCI slots are included on a riser card.

The unit's performance on our tests was slightly above average. The E-1000N, like Gateway's other products, can be configured and purchased via the company's Web site. Gateway offers 24-hour technical support and has next-business-day parts-replacement service. Featuring impressive performance and a generous warranty, the

Gateway 2000 E-1000N 233

E-1000N is a good choice.—*RSA*

Gateway 2000 E-1000N 233. Direct price: $1,019. Gateway 2000 Inc., North Sioux City, SD; 800-779-2000, 605-232-2000; fax, 605-232-2601; www.gateway.com. *Choose 549 at www.pcmag.com/infolink.*

HP Net Vectra

PC MAGAZINE EDITORS' CHOICE

Though this Pentium MMX/166–based system could not match the performance of some of the more robust Net PCs we tested, the HP Net Vectra ($1,210 street) holds its own as a solid managed PC with one of the best management packages around. (At press time we learned that this unit had been replaced by 200-MHz and 233-MHz Pentium MMX–based models with the same management features.)

The Net Vectra offers the same DMI 2.0–compliant management features as

HP Net Vectra

the other Vectra units, which include the Vectra VE series of value-priced Pentium MMX PCs and the Vectra VL line of performance PCs based on the Pentium II and Pentium MMX.

The lockable case opens easily after you disengage two rear clips; there is no intrusion alarm. Its NLX-style motherboard includes a SiS PCI chip set, two USB ports, and an S3 Trio 64V2/DX graphics chip set but lacks integrated audio or Ethernet circuitry. A 1.6GB hard disk handles storage. A riser holds two PCI slots; one hosts an HP 10/100-Mbps Ethernet card.

The system supports Wake on LAN and comes with HP's NightDirector remote power-up software and HP's excellent TopTools 2.6 desktop management application. In addition to standard asset management, TopTools lets you remotely update the BIOS and remotely lock components such as the hard disk, floppy disk drive, keyboard, and mouse. The unit also offers hardware monitoring.

A tiny heat pipe transfers heat from the CPU to a large heat sink near the front of the unit. The keyboard includes an Instant-On start key.

The Net Vectra performed as expected on our tests, finishing behind most of the 200- and 233-MHz Pentium MMX–based units seen here. A Pentium MMX/200–based Net Vectra is $1,340 (street), and a Pentium MMX/233–based model will be available by the time you read this.

HP backs the unit with a three-year warranty with a year of on-site service. The system's manageability features and support offerings more than make up for its performance.—*RSA*

HP Net Vectra. Street price: $1,210. Hewlett-Packard Co., Palo Alto, CA; 800-322-4772, 650-857-1501; fax, 800-231-9300; www.hp.com/vectra. *Choose 508 at www.pcmag.com/infolink.*

Sherwood Passport

The Sherwood Passport Net PC offers a great price ($1,100 street, with 15-inch monitor) and a clean, slim design with excellent connectivity options. The unit lacks security features some users may require, however, and it performed below average on our tests.

Sherwood Network Division also markets the 8000PT Network Computer, a unit that shares many hardware features with the Passport. The 8000PT is now available in a JDK 1.1–compliant version.

Like some Windows terminals, the Passport can boot locally or from a server in a variety of operating systems, including some Unix versions. Sherwood offers its own server 8000PT Remote Boot Configuration Tool to manage and configure client desktops (this software is standard).

The Passport's only fan is on the CPU, but the sides of the nonlockable case are dotted with holes, permitting adequate ventilation. The small-footprint case is only 2.5 inches high, but its rear panel offers more connectivity than most Net PCs: The product includes a MIDI port, three audio jacks, two serial ports, a parallel port, and a 10/100-Mbps Ethernet jack.

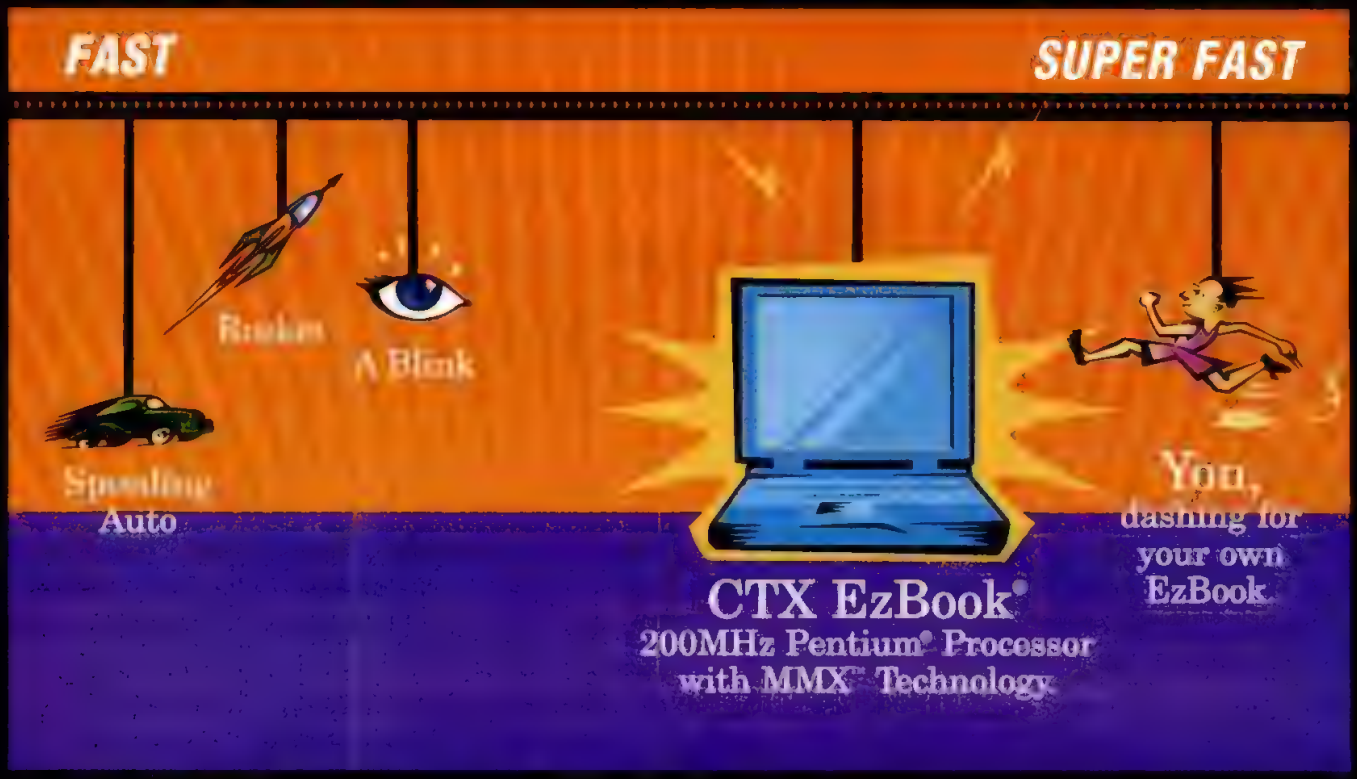
The unit's motherboard integrates features such as a 16-bit audio chip set, a graphics chip set, and a floppy disk connector. The motherboard also has a PCI slot; a

Sherwood Passport

Card Bus connector for PC Card support is included for future implementation.

The Passport's Pentium MMX/166 CPU kept its performance down on our tests. The Sherwood unit combines a good design with a nice price.—*RSA*

Sherwood Passport. Street price: $1,100. Sherwood Network Division, Hayward, CA; 800-777-8755, 510-266-5600; fax, 510-266-5627; www.sherwoodterm.com. *Choose 551 at www.pcmag.com/infolink.* PC



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BY FRANK J. DERFLER, JR.

You can make a dent in the total cost of ownership (TCO) of your PCs and network devices with some simple actions. If you already know you want to replace some or all of your PCs with thin clients or Net PCs, this issue's feature "The New Networked Computers" should help you choose the right products. In this issue's Net Tools section, we look at the infrastructure needed to use those clients.

Each time we look at thin clients and client management tools at PC Labs, however, we conclude that you can get many of the benefits of thin client hardware by simply adding some management software to the PCs you buy. At the same time, thin clients come with their own costs. Our April 7, 1998, issue contained several stories detailing the challenges of introducing the Java applications typically associated with network computers. If you choose clients that rely on servers for processing and management, then you'll have to invest money to ensure the reliability of your servers.

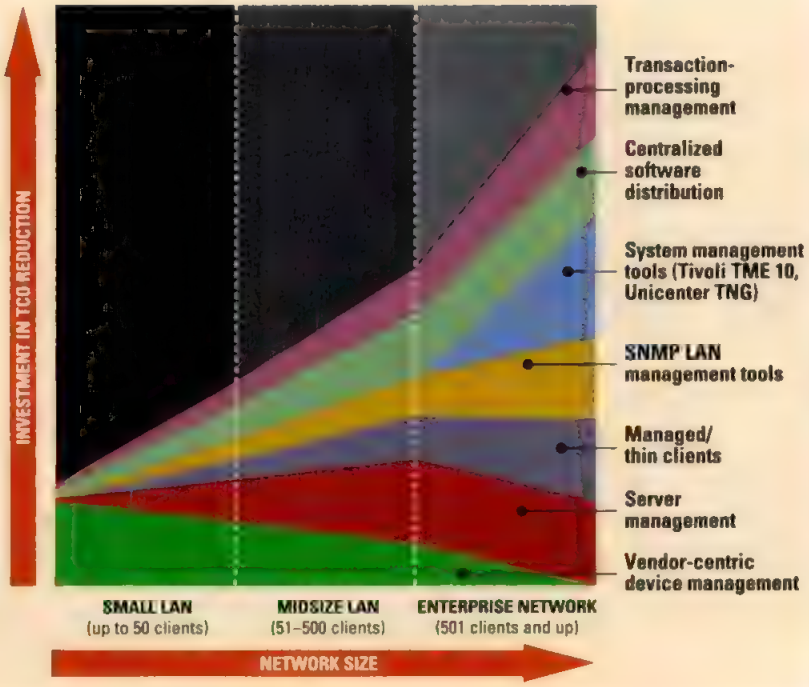
To keep network costs at appropriate levels, you should invest in management software that can monitor network traffic. You can start managing your hubs and network interface cards with simple, sometimes proprietary software, then move up to SNMP-based management tools as your network grows.

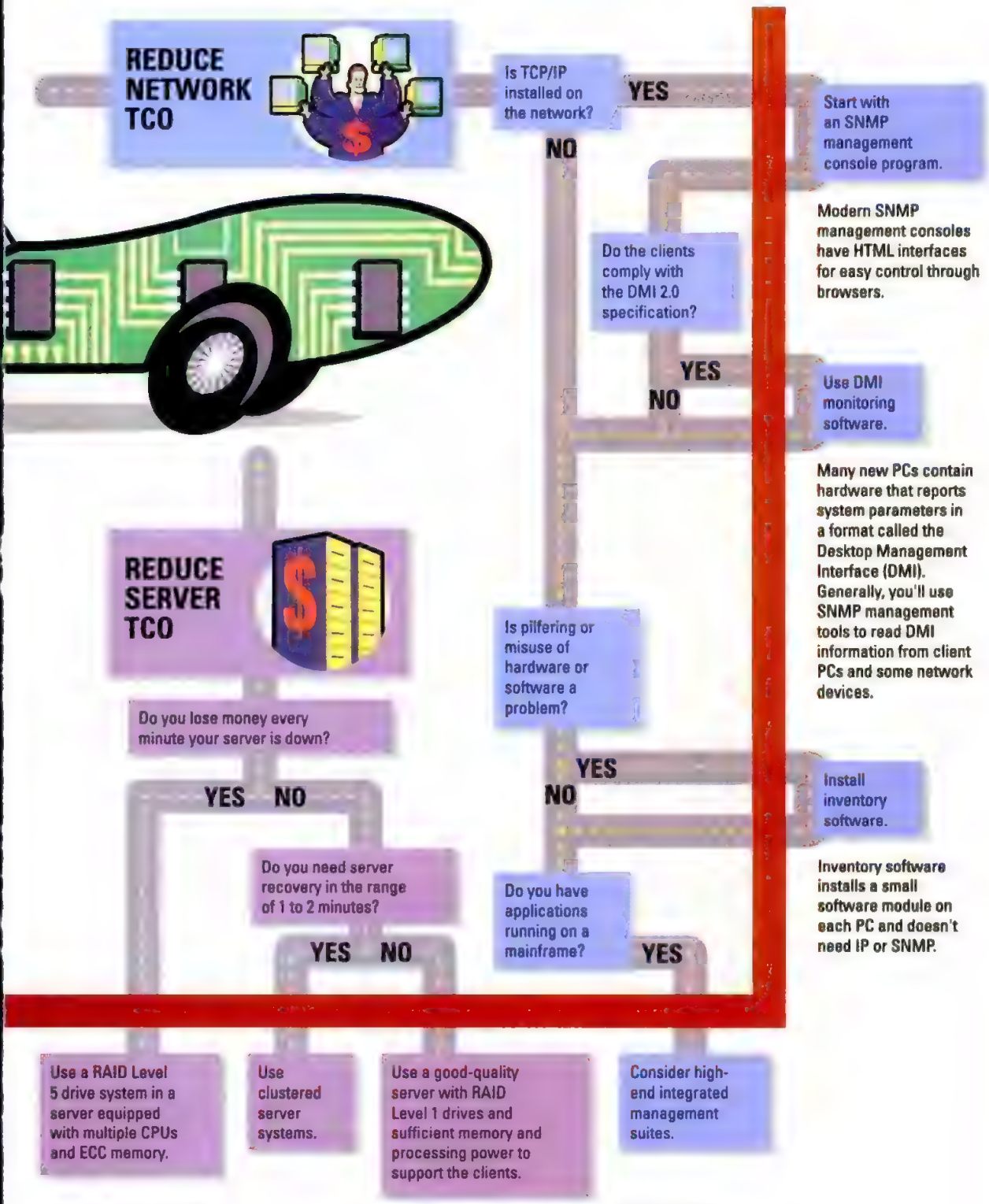
Keep in mind that the benefits of various TCO techniques vary with the size of your network, your corporate line of business, your IS organization structure, and many other factors. It takes custom studies to predict exactly what cost-control benefits you'll obtain by adopting a specific TCO strategy. We can supply you with some guidelines for TCO strategies, however.

This special gatefold section includes a decision matrix chart ("Your TCO Roadmap") that takes you through the logic of your TCO options. A special graphic at the bottom of this page describes the spectrum of options that apply to businesses of different sizes. Finally, we give you a TCO questionnaire to help you estimate your own high-payback areas for TCO control and answer the questions that need to be asked when considering any TCO reduction strategy. On our Web site, we provide a page of links to Web pages posted by IBM, Intel, Microsoft, and various consulting groups (*www.pcmag.com/special/tco*).

TCO and Your Growing Network

As your network grows, the relative importance of different TCO strategies changes. Vendor-centric device management declines in importance while centralized SNMP LAN management, managed client software distribution (or thin clients), and transaction-processing management become essential. The largest networks can truly benefit from high-cost management tools such as Tivoli Systems' Tivoli TME 10 and CA's Unicenter TNG.





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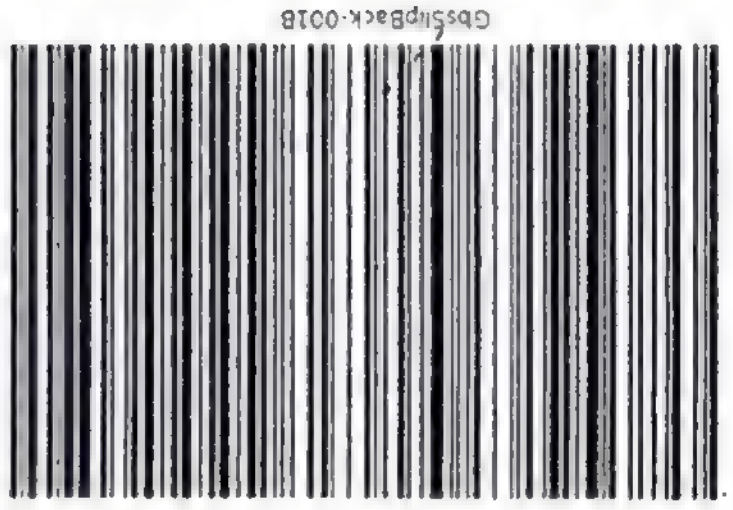

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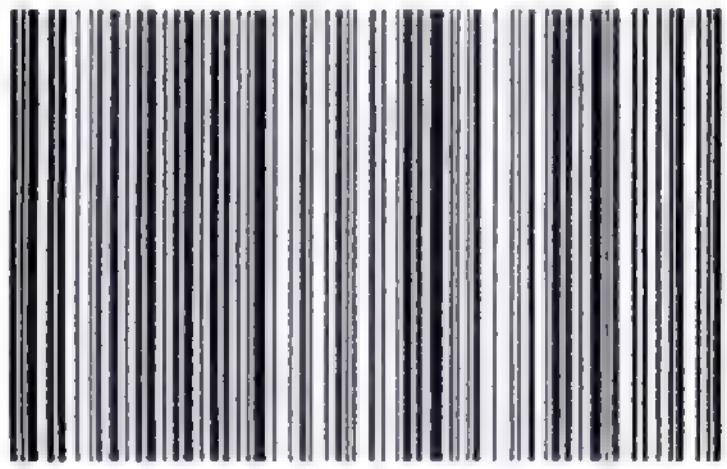

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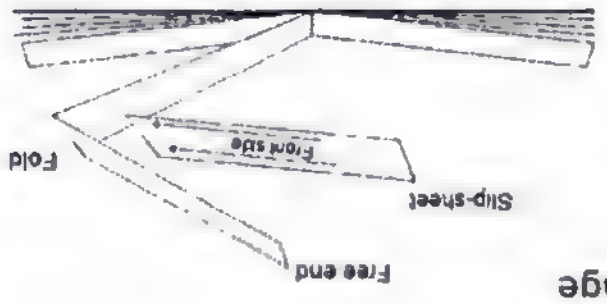

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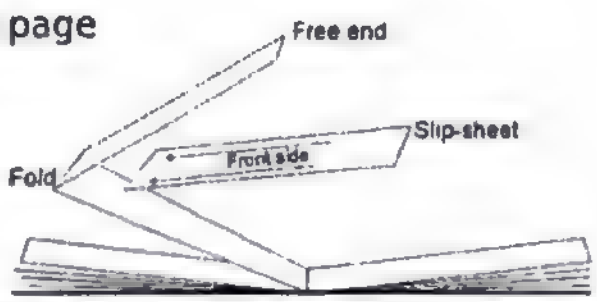
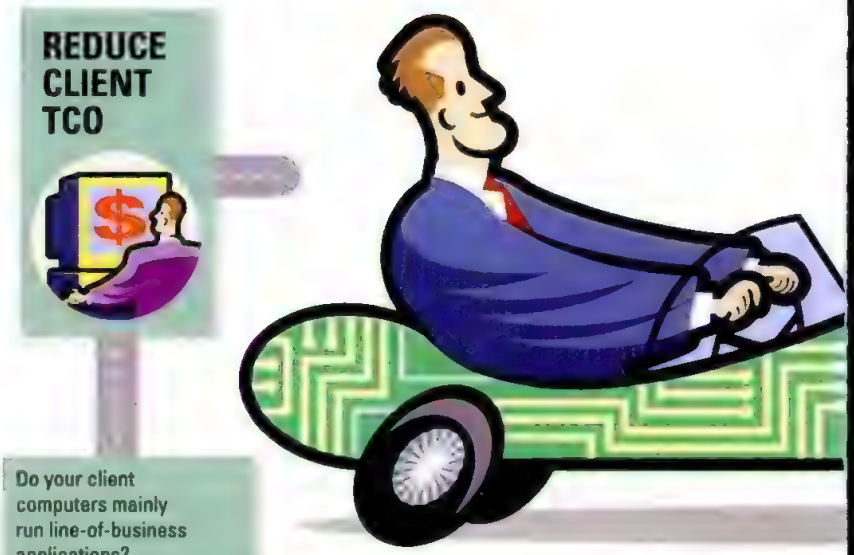


TCO Strategy Road Map

Your new bonus plan pays you to control the operating budget. Here is your guide to reducing your total cost of ownership.



Do your client computers mainly run line-of-business applications?

YES NO

Is physical security or a harsh environment a problem?

YES NO

Is your principal application client/server-based?

YES NO

Do you want to rewrite the application?

YES NO

Do the users run any other applications?

YES NO

Do you want to go to Java?

YES NO

Do you have sophisticated computer users?

YES NO

SOLUTIONS

Consider Net PCs or browser/Java-equipped NCs.

Net PCs offer security and Windows applications. For Java- or HTML-based NCs, you'll have to create HTML screens for your applications, but they may be the most disposable clients in harsh environments or environments with poor physical security.

Consider using managed PCs.

Consider using Net PCs or Windows-based terminals.

Make the decision based on the existing infrastructure and the sophistication of your users. Users with desktop PC experience would probably prefer Net PCs.

Consider Java NCs.

See the April 7, 1998, issue of *PC Magazine* for more information on the Java environment.

Consider using Windows-based terminals.

Our testing shows that Windows-based terminals are a good Windows front end for a back-end database server.

Consider managed PCs.

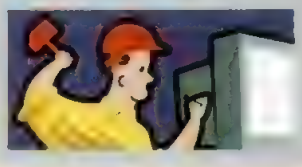
Managed PCs offer excellent flexibility for demanding users.

Consider using Windows-based terminals.

Windows-based terminals can deliver the commonly used Windows applications at a low cost per seat but may not do everything demanded by a sophisticated user.

TCO Questionnaire

Before you attack each TCO problem with a cost-reduction strategy, there are many questions you must ask yourself.

TCO Element	Control Method	Ask Yourself...	
CLIENT ACQUISITION COSTS	Acquire Windows terminals, Net PCs, or Java-based network computers.	• Are you paying too much for PCs? • Can you get the power your users need by purchasing sub-$1,000 PCs? • If you choose Java NCs, are you prepared to rewrite most of your applications in Java? • In addition to client costs, what additional server and infrastructure costs would result from installing thin clients?	• Would the dollars spent on infrastructure, Java software development, and thin client acquisition add up to less than the acquisition costs of traditional PCs? • Will your users' applications run acceptably fast on a Windows terminal? • Are there power users in your organization who will not accept anything less than a fully functional PC?
TROUBLESHOOTING SELF-INFLICTED USER PROBLEMS	Acquire Net PCs, Java NCs, or Windows terminals, or use policy management software.	• How many person-hours per day do you spend addressing user-created problems? • What are those person-hours worth in dollars? • What user-inflicted problems would be avoided with locked cases and policy management software or by using thin clients? • If you choose Java NCs, are you prepared to rewrite most of your applications in Java?	• In addition to client costs, what additional server and infrastructure costs would result from installing thin clients? • How long would it take for the troubleshooting dollars saved to pay for the acquisition, infrastructure, and software development costs of thin clients? • Will your users' typical applications run acceptably fast on a Windows terminal?
REPAIRING CLIENT PC HARDWARE PROBLEMS 	Use thin clients and swap them out when problems occur.	• How many person-hours per day do you spend fixing hardware malfunctions on desktop PCs? • What are those person-hours worth in dollars? • If you choose Java NCs, are you prepared to rewrite most of your applications in Java? What would that cost in person-hours and dollars?	• In addition to client costs, what additional server and infrastructure costs would result from installing thin clients? • How long would it take for the savings in hardware-problem resolution to pay for the software development, infrastructure, and acquisition costs of new thin clients? • Will your users' typical applications run acceptably fast on a Windows terminal?
UPDATING SOFTWARE ON INDIVIDUAL PCs	Install centralized software management or replace PCs with Windows terminals.	• How many person-hours do you spend updating software on clients? • What are those person-hours worth in dollars? • How much would a software distribution system cost? • In addition to client costs, what additional server and infrastructure costs would result from installing thin clients?	• How long would it take for the dollar savings in client updates to pay for the cost of a software distribution system? • How long would it take for the dollars saved in client updates to pay for the acquisition, infrastructure, and software development costs of thin clients? • Will your users' typical applications run acceptably fast on a Windows terminal?
COST OF PILFERED EQUIPMENT OR SOFTWARE	Install centralized inventory-control software or thin clients with software running on back-room servers.	• How much money does your company lose as a result of hardware and software pilfering? • How long would it take for dollars saved from pilfering prevention to pay for the cost of an inventory-control system? • If you choose Java NCs, are you prepared to rewrite most of your applications in Java? What would that cost in person-hours and dollars?	• In addition to client costs, what additional server and infrastructure costs would result from installing thin clients? • How long would it take for the dollars saved from pilfering prevention to pay for the software development, infrastructure, and acquisition costs of new thin clients? • Will your users' typical applications run acceptably fast on a Windows terminal?
LOST REVENUE DUE TO SERVER PROBLEMS	Install high-availability server alternatives such as RAID Level 5, multiple CPUs, or server clustering.	• How many hours per year on the average does a server go down? • How much money do you lose as a result of this server downtime? • How much are you willing to pay for uninterrupted service? • Can you consolidate server functions into a single piece of hardware and gain reliability and better device management?	• Can your balance sheet benefit from the aggressive server packaging and leasing plans available from many vendors?
LOST REVENUE DUE TO NETWORK SLOWDOWNS OR OUTAGES	Use network management to find bottlenecks and guide upgrades.	• Do you know your network bottlenecks? • Are there administrative actions, such as rescheduling database updates or backups, that would level out traffic surges? • Would restructuring actions, such as more network segmentation or switching, help traffic flow? • Is it easier simply to add bandwidth than to add bandwidth and system management?	• Are you ready for the software updates, software customization, and administrative management burdens of a system management suite?

ILLUSTRATIONS BY ALAN BASDEN

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And *erasing* them.

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MMX intel inside pentium® processor

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Intel 233MHz Pentium II processor
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512KB integrated cache in SEC package
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5 expansion slots: 4PCI, 1 ISA
Integrated Adaptec PCI Ultra Wide SCSI-3 controller
Intel EtherExpress™ Pro 100 network adapter
20X SCSI-2 CD-ROM drive
Upgradable to 36GB storage
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5-year/3-year Micron Power℠ limited warranty
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512KB integrated cache in SEC package
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Dual integrated Symbios Ultra Wide SCSI-3 controller
Integrated Symbios narrow SCSI controller
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[1]On-site service for NetFRAME LV2001 and MV5001 server is provided by Digital Equipment Corporation and is optional.

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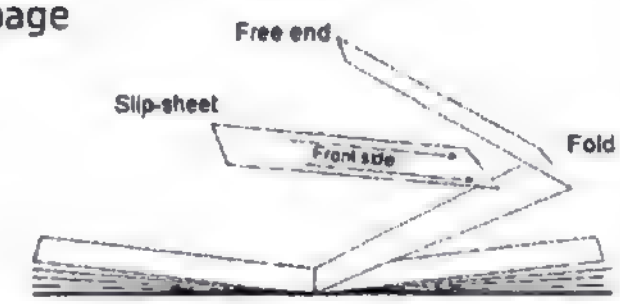

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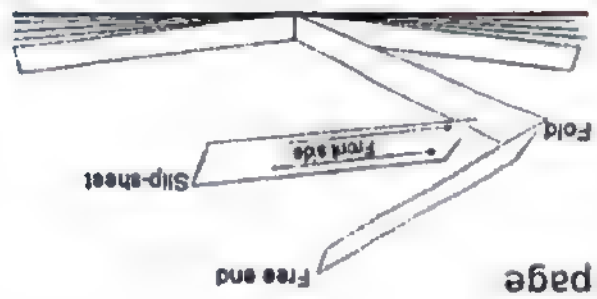

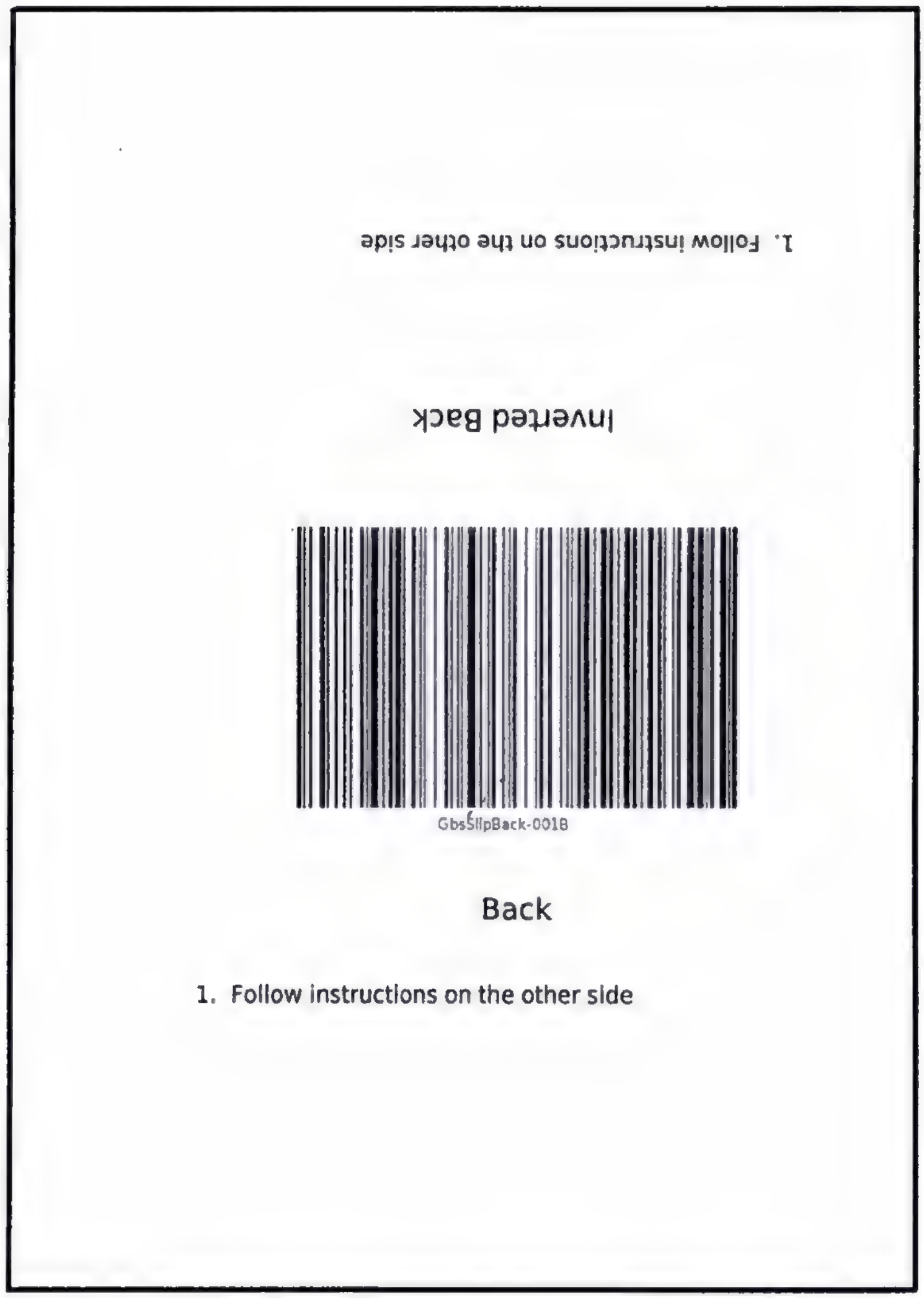
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24X variable speed ATAPI CD-ROM drive
4MB AGP 3D video
Network adapter with 3Com Remote Wake Up™ capability
Microsoft IntelliMouse
Intel LANDesk Client Manager available
Advanced Hardware Monitoring and Power Management features
Chassis intrusion alert
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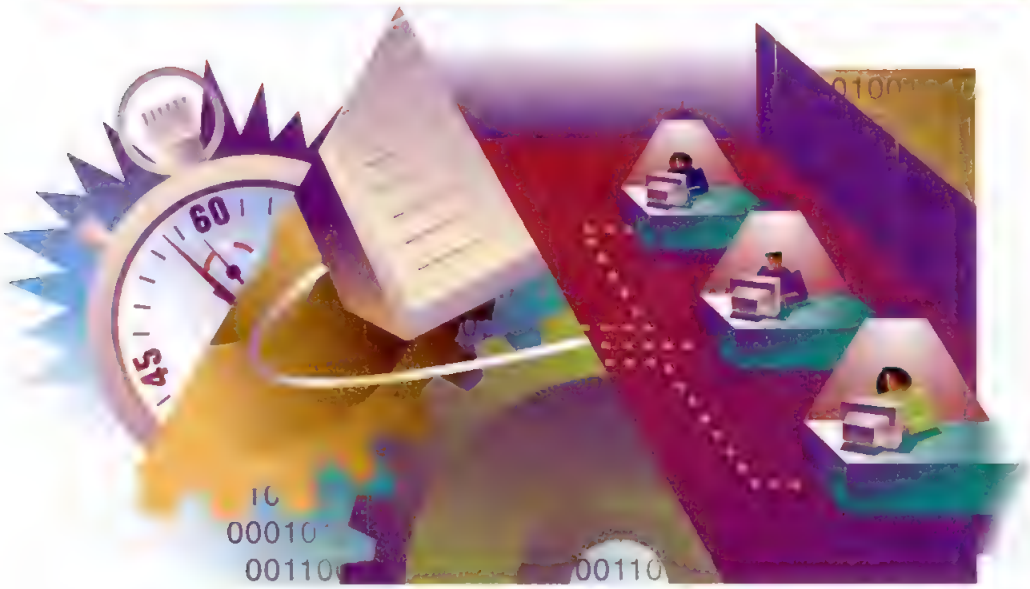


ILLUSTRATION BY DENNIS HARMS

Thin Clients, *Robust* Servers, *Husky* Nets

PC Magazine Labs built its network of thin clients and Net PCs to test the infrastructure realities of a lean-client strategy.

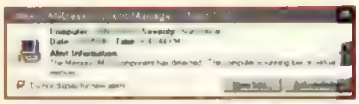
By Frank J. Derfler, Jr.

You can't get something for nothing. Compared with traditional PCs, the thin clients and Net PCs reviewed in this issue's feature "The New Network Computers" can provide significant cost-control benefits. They reduce the amount of time your IS staff spends walking around installing applications and troubleshooting hardware and user-inflicted problems on client PCs. But despite any ads for these PC alternatives you might have seen on television, you don't simply plug in thin-client, Net PC, or NC hardware and start saving money. Depending on the type of system you install, you'll need either strong servers, husky networks, or both.

In order to see for ourselves what is involved in implementing a thin-client or Net PC strategy, we brought over 50 units into PC Magazine Labs' network-testing facility in Foster City, California. We set up workgroups of 30 Wyse WT2510SE Winterms and 28 Hewlett-Packard NetVectra Net PCs. We were also hoping to set up a network of Java NCs. Unfortunately, we found that though there is a lot of talk about this

INSIDE

THIN CLIENTS: PC Magazine Labs and senior networking editor Frank J. Derfler, Jr.,



examine managed PCs, Net PCs, and Windows terminals and look at strategies for deploying these less expensive cousins of the normal PC.

POWER MANAGEMENT: Contributing editor Steve Rigney looks at the APC MasterSwitch and the Server Technology Sentry R-2000, which lets you flip your equipment's power switch from across the Internet. *Page 257.*

POWER PLAY: Will millions of Californians pull the plug on their electricity providers? PC Magazine Labs director Steve Buehler examines the aftereffects of deregulation. *Page 258.*

SERVER MANAGEMENT:

This time, hard-working Steve Rigney checks out Seagate's Manage Exec 5.0, which lets you manage your Windows NT and NetWare servers simultaneously. *Page 260.*

DYNAMIC CONTENT: Nothing remains static on the Internet. Contributor Jeff Downey looks at a slew of solutions that add dynamic content to Web pages. *Page 271.*

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NetTools Online
To check out this story and our online archive of networking coverage, visit our Web site.

new platform, acquiring one or more is another story. IBM and Sun Microsystems chose not to participate. Tektronix's NC series was not compliant with JDK 1.1, the most current version of the Java development kit. Network Computer Inc. (NCI) did not send us products in time.

For comparison, we set up 28 traditional PCs, as well as five Compaq Deskpro 6000 series managed PCs to examine the total cost of ownership (TCO) control features of a managed PC-based network. And we factored in our experience with OS and software-distribution applications for traditional PCs, such as Intel LANDesk Configuration Manager (see "Configuration Made Easy," April 21, 1998), Intel LANDesk Management Suite, and Microsoft SMS.

As the back-end infrastructure for our Wyse Winterms, we set up two servers running the latest release (Version 1.7) of Citrix WinFrame. WinFrame uses Citrix's MultiWin technology to turn Windows NT Server into a multiuser application server. It also uses its Independent Computing Architecture (ICA) protocol to send only GUI updates to a PC or other device running WinFrame's thin-client software. In an agreement with Microsoft, Citrix's MultiWin technology will be integrated into Microsoft's upcoming Windows Terminal Server, due in the second half of 1998. Windows

POLICY MANAGEMENT

The Futz Busters

By Steve Rigney

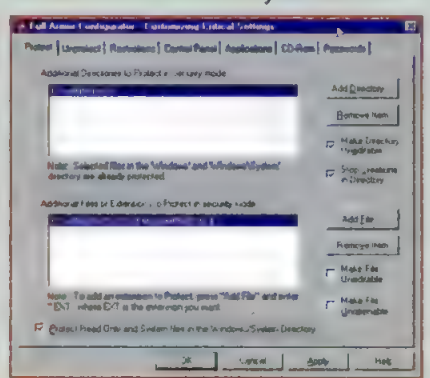
A large percentage of the costs and problems associated with desktop PCs are inflicted by users "futzing" with their system settings or accidentally deleting important system files. Policy management software such as Micah Development's Full Armor Zero Administration (FAZAM) and Microsoft's Zero Administration Kit (ZAK) can help you put an end to user tinkering. Both are available for Windows 95 and Windows NT, letting you control which files and applications your users can access.

Starting at $50 (list) per node, **Full Armor Zero Administration** (FAZAM) offers three levels of protection: none, Critical, and System Freeze. No protection means that the software resides on the system but the user can access and alter all the operating-system settings. The Critical level is our favorite, because it offers base-protection settings that you can customize further.

For example, we were able to hide files and directories, remove the Run and Find command from the Start Menu, disable individual Control Panel applets, and even determine which CD-ROM titles users could access. The System Freeze level provides maximum security by blocking access to all of the system's settings. It even prevents users from booting up their systems from a floppy disk.

If you choose to use FAZAM in the Critical mode, you'll need to configure your policy settings manually. FAZAM's Configurator utility looks like a standard Control Panel applet, complete with tab-style menu for configuring directory access, passwords, and other settings. The product is extremely easy to use and you probably won't need to refer to FAZAM's online documentation. After you use the Configurator utility to set up your protection scheme, you can save it and assign a password to prevent unauthorized changes to the scheme.

FAZAM takes a quick snapshot of the system settings during installation. You can use this feature later in conjunction with



THE FAZAM CONFIGURATOR *lets you disable certain system settings, such as the Run and Find command on your Windows 95 desktop.*

FAZAM's Undo utility to help recover a system after encountering any user-inflicted (or other) problems or detrimental system changes.

Micah also offers a Network Configurator utility (starting at $15 list per node) that lets you assign FAZAM settings to individual PCs, users, groups, and domains from a central location. After you create these protection schemes, you can use Windows-based policies or NetWare log-on scripts to send the new policies to your users. Unfortunately, you still have to install the FAZAM utility directly on every system. (Micah Development Corp., Cambridge, MA; 800-653-1783, 781-641-1500; fax, 781-641-1973; www.fullarmor.com. *Click on 900 at www.pcmag.com/infolink.*)

Unlike FAZAM, the free **Microsoft Zero Administration Kit** isn't a standalone PC solution. Instead, you load software on a domain controller running Windows NT Server 4.0 and define policies and profile settings. On the client side, ZAK works with systems running Windows 95 and Windows NT workstation.

ZAK offers you two configurations during installation: Appstation Mode and Taskstation Mode. Appstation Mode lets you limit end users to accessing a set of applications, such as standard word-processing, spreadsheet, and database applications. The Taskstation Mode is a subset of the Appstation Mode and permits users to access only a single application. Appstation Mode users see an abridged version of the Start Menu which includes just the appropriate program entries, whereas Taskstation Mode users do not even see the Start Menu on their desktops.

To create a ZAK client, you will need to boot your PC to the network. This can be done by using a boot disk or employing a network adapter equipped with a boot PROM. After the system is connected, you need to point it to the setup and distribution point on the ZAK server. The server then performs an unattended installation of the operating system, including service pack files, Microsoft Internet Explore 3.x, your office applications such as Microsoft Office 97, and the profiles and policies.

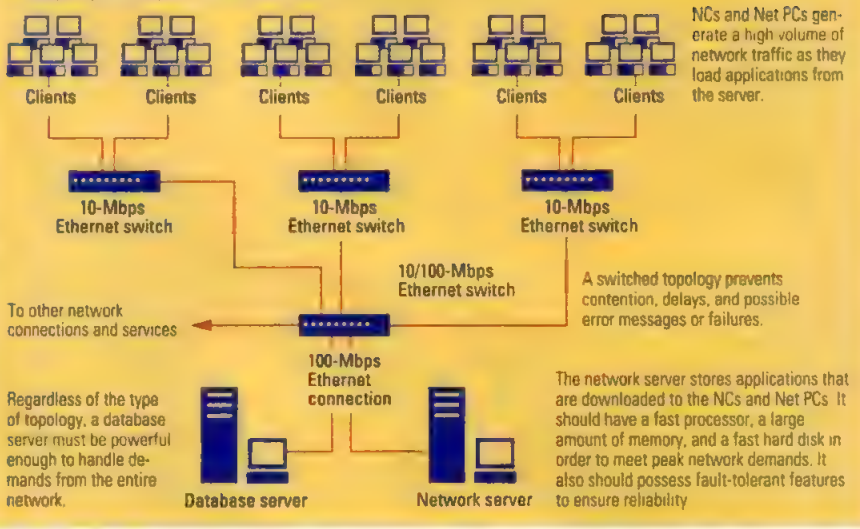
If you don't want your network bandwidth tied up with an across-the-wire installation of the operating system and applications, you can install the applications locally by using multiple CDs or an Iomega Jaz drive. (Microsoft Corp., Redmond, WA; 800-426-9400, 425-882-8080; www.microsoft.com. *Click on 901 at www.pcmag.com/infolink.*)

Terminal Server will use the Remote Display Protocol (RDP), similar to ICA, to provide thin-client software for Windows 3.1, Windows 95, and Windows NT. Citrix plans to market another product, currently codenamed pICAsso, that will complement Windows Terminal Server—providing the ICA protocol and thin clients for DOS, Java, Macintosh, and Unix, with added management capabilities and server-load balancing.

We integrated these servers and clients using a multisegmented Ethernet network with an Oracle database server running a custom application that browsed, searched, and sorted a large database. We ran the same database application with Net PCs and standard PCs, and we exercised different application-software loading scenarios. We also ran some macros in Microsoft Excel from our Windows terminals while several clients were running the database applications in the background.

Network-Centric Infrastructure

This topology is designed for NCs and Net PCs.



For our Net PC configuration, we set up PC units two ways—running and storing applications locally, as one would with a traditional PC, and as lean clients that cache applications locally with user files and applications stored permanently on the server and downloaded at boot-up. The latter scenario reflects Microsoft's original strategy for Net PCs (and could be used with traditional PCs), which would employ the upcoming Intellimirror feature of Microsoft's Zero Administration for Windows strategy. Planned as either an add-in or part of Windows NT 5.0 and Microsoft System Management Service (SMS)—Microsoft hasn't announced its plans formally yet—Intellimirror will permit remote booting from a Windows NT 5.0 server, software distribution, and data caching. This lets the network administrator store user preferences, applications, and data on the server. Intellimirror is still unavailable, but we did our tests using the capabilities of Windows NT Server 4.0.

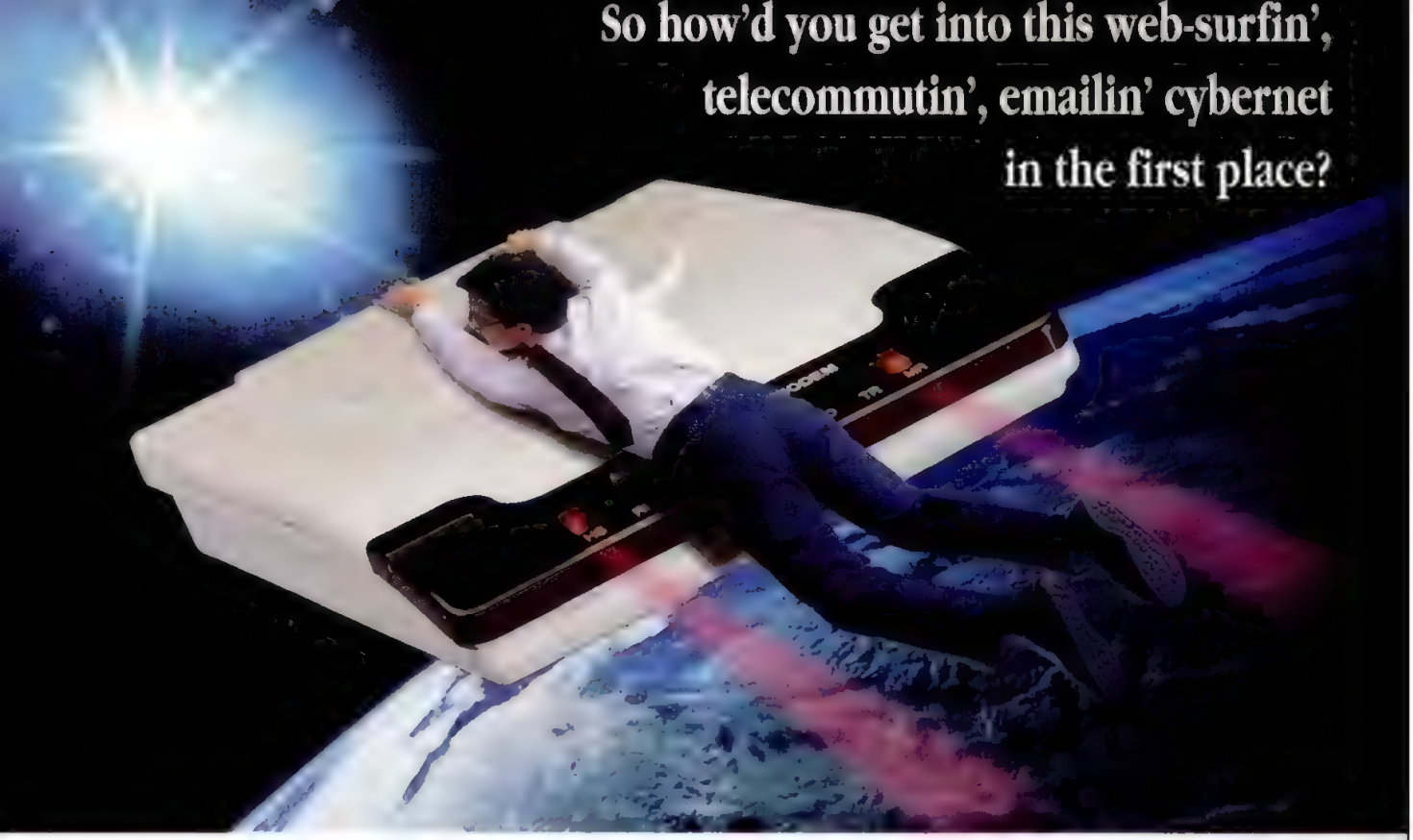
Through these installations, we gained insight into the capabilities of thin-client solutions as well as managed PCs and the servers and infrastructure they require. We found that the old rules apply. Network segmentation is good, and with network-centric clients such as Net PCs, more segmentation is better.

What is the way to achieve the greatest reduction in TCO of your client hardware? If you have unsophisticated users performing only one or two tasks such as data entry, along with occasional use of traditional Windows-based productivity applications, you can't beat Windows terminals like the Wyse systems we tested. Windows terminals and shared CPU systems can save you money

Comparing PC Alternatives

Alternative clients fall into three major camps. Keep in mind, however, that several products combine the features of Microsoft Windows terminals, Java NCs, and traditional text-based terminals.

	Benefits	Trade-offs	Best use
Net PCs Example: HP Net Vectra	• Server-based OS and applications permit centralized control and upgrades. • Uses standard Windows applications. • Locked case and floppy disk or CD-ROM drive prevent users from installing their own hardware and software or taking files away.	• Competitively priced against standard PCs, but proper management requires special training and software, which add to the price tag. • Creates high-peak network loads while applications are downloading to the client hard disk. • The file server can be a central point of failure. • To load applications quickly, the file server needs fast hard disks and a large RAM cache	• Environments in which security is important and users perform only a few tasks yet want access to Windows applications with the performance of local processing.
Windows terminals Example: Wyse Winterm WT2510SE	• Few internal components, permitting easier swap-outs and inventory control. • Server-based OS and applications permit centralized control and upgrades. • Uses Windows applications and application-development environment. • Screen updates and keystrokes cause very little network traffic • Low-cost client hardware	• Requires a shared CPU server, which may introduce a single point of failure • Additional cost in training and software • Former PC users will sacrifice performance and flexibility	• As terminal replacements or for access to centralized data, but where users need occasional access to Windows business applications
NCs Example: Funai Network Computer	• Few internal components, permitting easier swap-outs and inventory control. • Centralized software control. • Software is stored on the server but processed locally. • In theory, Java applications are platform-independent.	• Java Virtual Machine's performance is slow, and its compatibility is erratic. • The load on the network and servers can be as great as the loads generated by Net PCs. • Few existing Java business applications. • Will often require customized Java software development.	• As terminal replacements or for access to centralized data.



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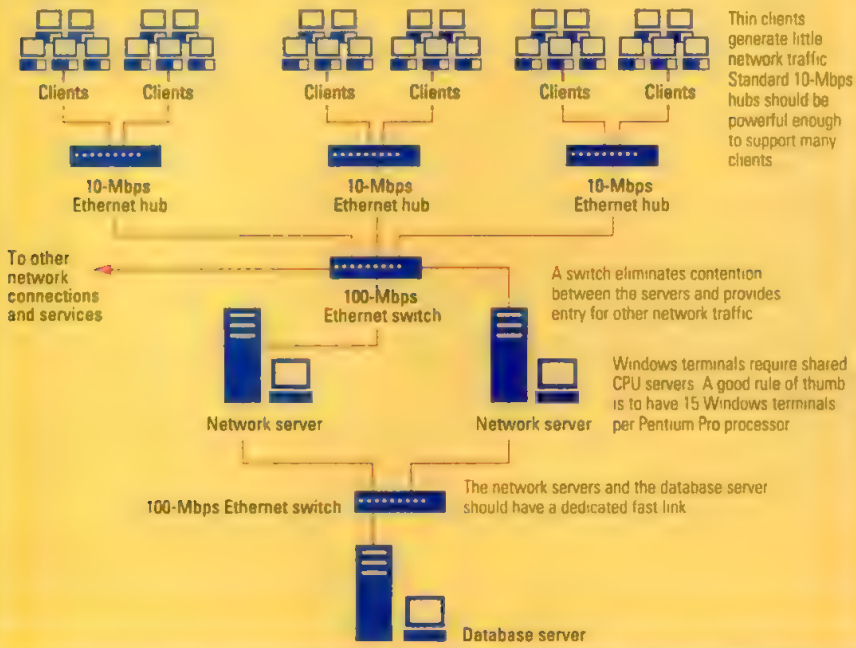
This topology is designed primarily for Windows terminals, but it can also be used for standard PCs and Net PCs.



both up front and over the long haul. Since they have no local storage and all processing is done on the server, Windows terminals let you centralize software updates on a few Windows NT-based servers rather than having to update every client, and they prevent users from installing their own hardware and software. There's no need to keep track of, manage, and constantly upgrade scores of different client configurations. And on our tests, Windows terminals actually generated far less network traffic than several traditional PCs that were accessing the same central database.

Even with 20 clients accessing the dual 200-MHz Pentium Pro test server, our Windows terminals simultaneously gave us database-application performance approaching that of a 133-MHz Pentium PC. Performance on our Excel macros was about 50 percent slower than with our 133-MHz Pentium PC but certainly fast enough for occasional use of Windows business software. The trade-off is that the shared CPU server works hard and the link between a Windows terminal server and a database server can be very busy. Your main costs will be in providing the servers necessary to run WinFrame or the upcoming Microsoft Terminal Server, as well as the robust connections between those servers and your database servers.

If you're using Net PCs as lean clients with hard-disk caches, we found that you can hit high-peak network loads when several of them load applications from servers at the same time—first thing in the morning on a typical weekday, for example. The same is likely to be true of Java NCs, which download applets from a central server. For these platforms, the bottom line is the need for more separate hubs and switches, a good wiring plan, and people skilled in network architecture. If you need more performance than a Windows terminal will offer, but more security and control than a PC, Net PCs offer a decent compromise. And with Net PCs, you can store applications on the client hard disks if you wish, just as you would with a regular PC.

We also found that you can significantly control the total cost of ownership of standard PCs by taking some simple measures. These include using DMI software and software update-and-distribution applications, as well as policy management.

The following sections, tables, and diagrams will take you through the back rooms of thin-client technology.

THE RIGHT PIPES FOR THIN CLIENTS

Windows-terminal thin clients aren't much more than a screen and a keyboard with a network-communications interface. One primary goal of our labs-based testing was to look at the network infrastructure needed to make Windows terminals efficient.

The network diagram "Server-Centric Infrastructure" shows how, based on our testing, we recommend structuring a system of approximately 30 or more Windows terminals with two separate, shared CPU servers. We're assuming a critical business application where downtime means lost revenue. The servers can balance loads, and terminals can run applications on each server as need-

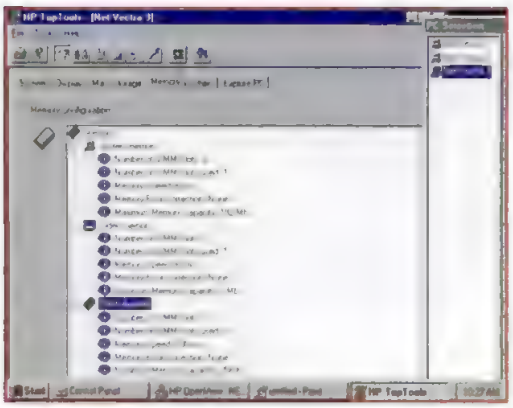
Managing Your PCs

Managed PCs provide many but not all of the TCO advantages of thin clients.

	Benefits	Trade-offs
DMI 2.0–compliant PCs with centralized management software Example: Compaq Deskpro 6000 series	• Provides detailed inventory information and system warnings and diagnosis. • Remote wakeup for after-hours diagnosis and for OS and software upgrades. • Not tied to a specific OS.	• Requires careful configuration of controls; system-boot images are optional. • If remote booting is used, one error can prevent all PCs from booting. • Management software requires IS staff training
Software and client OS distribution tools Examples: Intel LANDesk Management Suite and LANDesk Configuration Manager	• Permits centralized installation and updating of client OSs, applications, and drivers across the network. • Reduces the need for trips to clients to install software and troubleshoot • Management suites come with additional capabilities such as software-license management and server monitoring tools	• Requires training of IS staff and careful planning for large-scale deployments • More efficient for large-scale initial installations than for individual customized updates.
Policy management software Examples: Micah Full Armor Zero Administration and Microsoft Zero Administration Kit	• Limits user access to client OS and application configurations	• Requires client software or a specific OS loaded on each PC • Requires training of IS staff.

ed. The database server has the horsepower to grind the numbers and would be used whether the client stations are standard PCs on a LAN or Windows terminals using a shared CPU system.

On our tests, we found very low network-utilization rates on the LAN connecting the Windows terminals and the shared CPU server. With 30 very busy clients, we saw peak network-utilization rates below 10 percent. Using the same database application with 28 PCs on a LAN, we saw utilization rates between the PCs and database server peak at over 80 percent and average at 30 percent. In the Windows terminal system, the utilization rate on a 10-Mbps link between the Citrix WinFrame server and the database server peaked as high as 83 percent, although 17 percent was the average. We conclude that you can comfortably install as many as 75 to 100 Windows terminals on a flat, unsegmented 10-Mbps network. We recommend using a switch as a portal to the rest of the network and to the servers. The link between the very active, shared CPU servers and the database server should be 100 Mbps.



HP's TOP TOOLS *stores device information in an ODBC-compliant database.*

We also found that about 15 clients per Pentium Pro processor on the server was the right configuration for our Windows terminal-network tests. After 15 clients, we saw performance start to fall significantly. The diagram "Network-Centric Infrastructure" shows how we recommend structuring a network to support Net PCs if you're using them to cache data and applications downloaded from a server.

On our tests, we tried loading Microsoft Word from a dual 200-MHz Pentium Pro server running Windows NT 4.0 with 256MB RAM and a 10-Mbps LAN connection—first onto one client PC and then simultaneously onto 30 client PCs. This is similar to what would happen at the start of business in an office using Net PCs with hard disks as caches. With one client, we found network utilization reaching 54 percent and loading times of about 4 seconds. With 30 clients, network utilization reached 98 percent and loading times averaged 53 seconds. We also found that with 30 clients, some machines failed to load the application on the first attempt. For these network-centric systems, we recommend servers with a great deal of cache memory and switched networks to reduce contention. The 10/100 switch we recommend will cost about $1,000, but it's good insurance to eliminate network contention during peak loads. Fast Ethernet connections between the server and the switch are a necessity.

WHAT'S THE COST?

Is a shared CPU system using Windows terminals and WinFrame less expensive to buy and own than a similar network of PCs? Generally speaking, the answer is yes and the benefit increases with the number of terminals. For example, we added up the price of 35 Wyse WT2510SE Windows terminals ($1,189 each with monitors, or $41,615). We also priced a hefty server to run those terminals (we went to Dell's Web site and priced a PowerEdge server with two 266-MHz Pentium II processors, 320MB RAM, a 6GB RAID 5 configuration, DAT backup, and a UPS; list price: $9,698). The Citrix WinFrame 1.7 software sells for $5,995 (list) for the first 15 users. A license for 20 more users costs $3,990. The total cost for a 35-node network of Windows terminals therefore adds up to $66,298 or $1,894 per user. The price of a new Dell OptiPlex GXa-managed PC with a 233-MHz Pentium II processor, 32MB RAM, a 3.2GB hard disk, a CD-ROM, and a 10/100 Ethernet adapter came to $2,169. Network infrastructure would be equivalent for both the Windows terminal and PC-based networks, and even with a less powerful server for the latter, you will still come out ahead with a Windows NT terminal configuration.

Do you gain more in the long term with Windows terminals and shared CPU sys-

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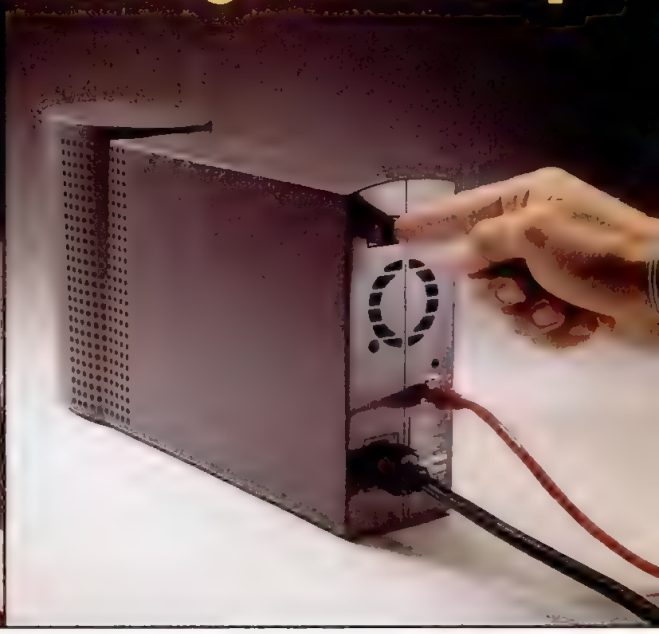

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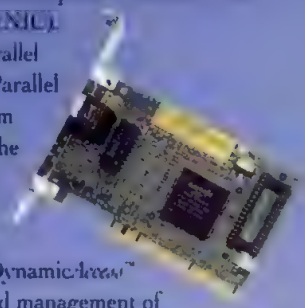

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tems? Yes again. We found that the Citrix system had logical utilities for administration. Administrators can restrict access to specific files, directories, and system areas on a user by user basis. Each user can have a specific profile, and that profile will load on any Windows terminal.

Running one of these systems is a special skill, but not a difficult one. Any network administrator with Microsoft Windows or NetWare experience will not have difficulty running a shared CPU system.

The decision to use Windows terminals or Net PCs comes down to the applications you're running, whether your users will accept having something other than standard PCs, and whether you are willing to invest up front in a central server that is redundant as well as reliable.

TCO AND MANAGED PCS

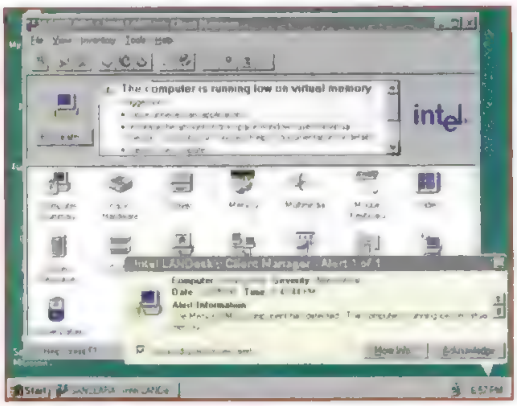
If you have a network of users that run more than a few applications and are simply unwilling to give up their traditional PCs, you can still reduce the cost of ownership for those units by using desktop management tools. The broad term desktop management includes functions such as performing inventory control of hardware and software, automating software updates, and placing limitations on the things that users can do to (and with) their own hardware and software. We found that a fully managed PC environment offers many, but not all, of the TCO advantages of a thin-client strategy.

Much of the credit for managed PC products goes to Intel's long-term sponsorship of a multivendor consortium, the Desktop Management Task Force (DMTF). The DMTF developed a standard for on-board management, the Desktop Management Interface (DMI).

Intel's embodiment of the DMI Version 2.0 standard in hardware is Wired for Management (WfM), and WfM-capable system boards began shipping in the fourth quarter of 1997. A WfM-equipped PC can report hardware inventory, system problems, and the status of certain USB and PC Card peripherals to a central management station. The station presents a view of important characteristics such as operation of the processor, BIOS, memory, drives, video, and communication ports, and the configuration files for each client. Depending on the platform, other features include remote wakeup of the computer across the network. Compaq, Dell, Hewlett-Packard, and IBM offer managed PCs with management packages that take advantage of DMI 2.0 features and that provide some additional bells and whistles as well. (For more information, see "Ultimate Management," *PC Magazine*, November 4, 1997.)

The Compaq Deskpro 6000 computers we set up in PC Magazine Labs have some serious cost-control features in addition to what DMI provides. They offer password-control access to the PC's setup menu, serial and parallel ports, removable media drives, and even the cover. Cost-control benefit comes with central management through Compaq's Insight Manager, a desktop management system that works with the client hardware and software. A client like the Deskpro 6000 provides Insight Manager with a hardware inventory down to the serial number of the hard disk, control of the password-protected resources, and reports of drive faults, case entry, high temperature, and a number of other problems.

We also set up HP's newest Net PC, the NetVectra, in PC Magazine Labs with the vendor's Top Tools central management software, which also comes with its managed PCs. Top Tools provides HP with entry into the management software arena. The new version, Top Tools 3.0, is a free and downloadable browser-interfaced system (*www.hp.com/go/vectrasupport*), scheduled for April release, that can display information gathered from DMI 2.0-compliant devices around the network. We were im-



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pressed with the ability of the program to put every device it discovered into an ODBC-compliant database. This goes a long way toward setting up a management structure, but you'll still have to add and edit a lot of information in the database. Once you have the database, you can search by chassis type, BIOS version, and many other factors.

You don't pay a premium for the management hardware in these managed and Net PC systems. The central management software is downloadable or included with servers. It isn't necessary to introduce IP into the network to gather DMI information. And in addition, the management software runs on any hardware. Managed PCs don't have an appreciable impact on the network infrastructure.

The trade-off for introducing management comes in the training needed to use the management features and in the time needed to keep up with the database, special passwords, and configurations. Our previous experience with SNMP products shows that keeping up the database is a daily task in a network of even moderate size. By contrast, there is little to keep track of in a network of Java NCs, Microsoft Windows terminals, or Net PCs. Client hardware will likely be identical or very similar across the board.

After several weeks of using managed machines in PC Magazine Labs, we conclude that the major benefit of desktop management comes from getting users back to work more quickly through faster diagnosis of problems. Using the password controls to keep users out of the system is a double-edged sword. It offers security but also adds a level of detail and complexity that begs for more problems. A little user education and some in-place policies might do as much good with fewer detrimental side effects.

LOCK DOWN AND SEND OUT

Policy management software, such as Micah Development Corp.'s Zero Administration for Windows 95 and Microsoft's Zero Administration Kit, both discussed in "The Futz Busters," bring some of the security of thin clients to the PCs already on your corporate desktops by preventing users from changing their settings and system files. Software management and distribution products such as Intel LANDesk Configuration Manager, Intel LANDesk Management Suite, and Microsoft SMS can update applications, drivers, and OSs on a system-wide or client by client basis over the network. The latter two packages also include several other management tools.

We have found in our testing of these Intel units and Microsoft SMS that software management products are primarily valuable for the deployment of new software releases across an organization. The greater the number of clients, the greater the gain. For sending specific software updates to specific clients, however, the benefits of centralized deployment and management versus walking around diminish significantly.

In the end, centrally managing your PCs today can only go so far in reducing your TCO versus implementing a Windows terminal strategy. The deciding factor is how many and what types of applications your users run, and whether they will accept more centralized control.

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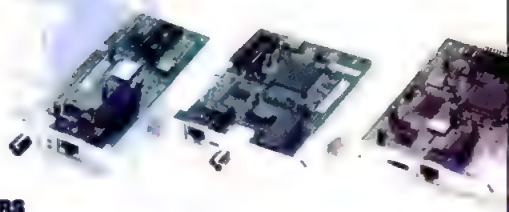

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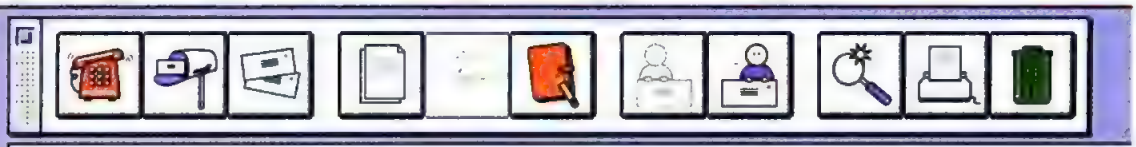

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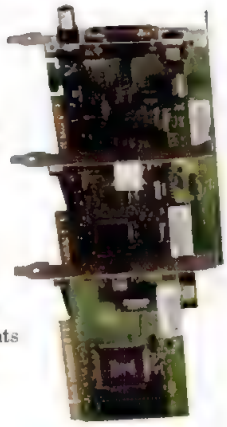

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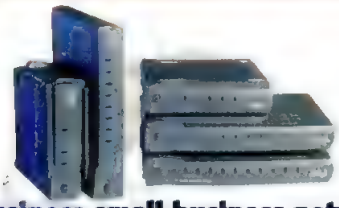

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Viking	2.2GB	Ultra SCSI-3	40MBps	512KB	$389.23	109238
Fireball SE	3.2GB	Ultra SCSI	20MBps	128KB	$339.91	109222
Fireball SE	4.3GB	Ultra SCSI	20MBps	128KB	$394.66	109226
Viking	4.5GB	Ultra SCSI	20MBps	512KB	$459.98	109239
Viking	4.5GB	Ultra SCSI-3	40MBps	512KB	$497.90	109240
Atlas II	4.5GB	Ultra SCSI	20MBps	512KB	$609.93	109241
Atlas II	4.5GB	Ultra SCSI-3	40MBps	512KB	$646.41	109242
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Fireball SE	8.4GB	Ultra SCSI	20MBps	128KB	$599.68	109230
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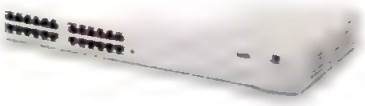

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Net Tools

FROM THE BENCH

POWER MANAGEMENT

Rebooting Across the Net

By Steve Rigney

At one time or another, any network device may hang and require a manual reboot. American Power Conversion Corp. (APC) and Server Technology offer products that let you save time and shoe leather by remotely rebooting your devices across the Internet, but that is where the similarities end.

Designed strictly for resetting the power on eight different devices, the APC MasterSwitch is a more basic and relatively inexpensive solution. It is extremely easy to use, and its Web-based interface makes the device accessible from any PC that includes a browser.

The higher-end Server Technology Sentry R-2000 provides the same basic functionality as the MasterSwitch. But it also offers more scalability and advanced options, such as an eight-port matrix switch and the ability to down and restart connected Microsoft Windows NT servers.

APC MasterSwitch

Although not as option-rich as the Sentry R-2000, the new APC MasterSwitch ($699 list) is an affordable solution that lets you cycle power to your servers and other devices through an Internet, SNMP, dial-up, or telnet connection. The unit comes with eight AC receptacles, a serial communications port, and a 10Base-T RJ-45 port. We especially liked the versatile Web-based management included with the product. If you need only to cycle power on remote servers using the Internet, intranet, or dial-up connection, the MasterSwitch is probably your best choice. But if you need the ability to do more than power your devices (performing a soft shutdown of your network devices, for example), you'll want to look elsewhere.

GOOD FOR BRANCH OFFICES, *the APC MasterSwitch lets you cycle power to your network devices from your Web browser.*

The MasterSwitch is housed in a slim 19-inch rack-mountable chassis. The AC receptacles are located on the back of the unit, and the management and Ethernet ports are on the front. Like the Sentry R-2000, the MasterSwitch has a simple LED display that shows at a glance the status of each port and of the unit. But the MasterSwitch differs from the Sentry R-2000 in that it does not include physical switches to turn the power ports on and off. And unlike with the Sentry R-2000, you cannot daisy-chain multiple units together for notably easier management.

We found the product quite easy to set up, which is fortunate since the manual is spare—only a few pages long. There are three ways to configure the MasterSwitch—either by using a terminal program through a modem or serial connection or by using a telnet or HTTP connection across a TCP/IP network. The telnet feature we tested was still in beta, but it worked well. We had to provide the unit with an IP address, but we were unsuccessful when we tried to use a Reverse Address Resolution Protocol (RARP) command to give the unit an IP address. Instead, we had to connect a terminal to the MasterSwitch's console port and then set up the IP information.

Our favorite feature of the MasterSwitch is the ability to control and configure it using a Web browser. The MasterSwitch also comes with an SNMP agent for control and management from an SNMP console application, but a browser provides more flexibility.

To use the Web-based management, all you have to do is point your browser to the IP address of the MasterSwitch and enter the correct user name and password. We found the Web interface extremely intuitive. Within minutes of connecting to the MasterSwitch, we could turn individual ports on and off and change the settings without rebooting the unit. In addition to cycling the power on the individual ports, we could change the unit's network settings, define the unit's name and location, read online documentation, and create dynamic links to APC and other Web sites so that a help desk could receive more information and technical support from the company.

APC MasterSwitch. List price: $699. American Power Conversion Corp., West Kingston, RI; 800-800-4272, 401-789-5735; fax, 401-789-2739; www.apcc.com. *Choose 903 at www.pcmag.com/infolink.*

Server Technology Sentry R-2000

Priced more than three times as high as the APC MasterSwitch, the Server Technology Sentry R-2000 offers the same base functionality, but it truly comes into its own when you begin incorporat-

MORE THAN MEETS THE EYE: *The Sentry R-2000 includes handy options, such as additional outlets and an 8-port matrix switch.*

ing the available options. The base unit ($2,199 list) lets you remotely cycle power through your devices using a dial-up connection and also lets you perform an orderly shutdown and restart your connected Microsoft Windows NT servers. The options include up to four additional managed outlets and a matrix switch that lets you manage multiple-network devices remotely through a single dial-up connection and their serial ports.

The Sentry R-2000 is a 19-inch rack-mountable unit that provides eight AC ports, individual port-reset switches, and two RS-232 serial ports. It also includes two power supplies: one for the first four AC ports and the other for the last four ports.

Like the MasterSwitch, the Sentry R-2000 is a breeze to install and required us only to connect our AC adapters, the Ethernet cable, and the RS-232 serial cable. The base unit is configured by using an out-of-band terminal connection. Server Technology also offers an optional LAN-based interface card that comes with a single 10Base-T RJ-45 port for $600 (list) or one with a 10Base-T port as well as two RS-232 ports for $800, which were included in our review unit. Using this option, you can configure and manage the product with a telnet utility running over an IP connection. But unlike the MasterSwitch, the Sentry R-2000 cannot be set up and managed via a Web browser.

As with the MasterSwitch, we tried using an RARP command to assign a temporary IP address to the Sentry R-2000 so that we could establish a telnet connection. Initially, we could not get this procedure to work and had to rely on a terminal connection to assign an IP address. We reset the unit twice, and the RARP method eventually worked.

To prevent accidental resets, you can use the terminal connection to disable the front-panel buttons. You also can restrict which IP addresses connect through a telnet session to the Sentry R-2000. This feature along with the system passwords makes it fairly safe to provide access to the product from the Internet.

The Sentry R-2000 comes with a single option slot, which

CROSS TALK

Frank Dorter

When your network devices hang, flipping the power switch and rebooting is often the best troubleshooting action. The MasterSwitch and Sentry R-2000 are particularly useful for temperamental communications and remote-access equipment. They're primitive but effective.

I've always said you were on a power trip, Frank. But I wonder about the importance of the browser-based management. I know it's popular now, but when dealing with such fundamental functions, I'd prefer to see a prewritten telnet script that directs specific actions.

Leon Erlanger

MULTIPLE ACCESS

The Power of Choice

Steve Buehler

A lot of trends begin in California. Some make it to the rest of the country, while others just wither away. A new trend gathering momentum in the Golden State and likely to affect you whether it makes it to your state or not is electric utilities deregulation. You should take a few minutes to prepare for the results of millions of Californians pulling the plug on their local electricity providers.

California has some of the highest electric rates in the continental U.S.—about 11.4 cents per kilowatt-hour (kwh), which is about twice the national average. Consumers love the idea of competition, and recent legislation lets business and residential customers choose their electricity providers. Advertisements from potential suppliers are flooding mailboxes across California. And the same thing is starting to happen in about a dozen other states across the country that are deregulating electric utilities.

Dropping prices and inviting competition should be a good thing, right? Well, only sometimes. The electric companies in the West routinely sell power back and forth, depending on local demand. With deregulation, the difference between the prices that customers in a state like Oregon pay (5.6 cents per kwh) and the charges that the market in California can bear may encourage utilities in neighboring states to trim back locally available power as they increase their power exports to a more profitable Californian market. It's possible that your electric company may start reducing that nice clean power you've been enjoying, so this is one of the reasons you should take a look at your current power situation.

You should have a disaster recovery plan in place for your entire IS operation. But if you don't, then start with a good look at power and surge protection. Serious companies work out complete disaster recovery plans that include backup machines or facilities, and prepared companies hold disaster recovery drills to make sure their end users will be up and running through rain, snow, and natural disasters—or power loss.

If you already have a disaster recovery plan, you should update it to include added servers and workstations. Your new loads should match the capability of your existing equipment. When blackouts occur, they are usually brief in duration, so being able to stay up and running for a few minutes is usually enough. Brownouts—periods of low voltage—can last longer, especially during the summer months, so remember that while you're planning.

If you don't have an uninterruptible power supply (UPS) for your critical servers, get one now. At prices ranging from $200 to several thousand dollars, UPSs from suppliers such as American Power Conversion Corp., Best Power, and Tripp Lite offer cheap insurance for times when the power stops and your users couldn't otherwise do their jobs.

The last thing to do is to check with your electricity supplier. Although no supplier I know guarantees the quality and availability of power, in the face of competition, utility providers may respond to pressure from customers to maintain adequate levels of clean power and avoid the surges and dips associated with dirty power.

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can be used to connect either Intelligent Power Modules (IPMs) or Server Technology's Any to Any matrix switch. Fortunately, you can daisy-chain up to eight Sentry base units together, so you are able to mix and match all of the different options.

The IPMs (starting at $60 list per unit) let you attach up to four additional managed power outlets to the Sentry R-2000's standard eight. You can locate them within 1,000 feet of the unit.

The Any to Any matrix switch ($600 list), our favorite option, provides eight RJ-11 ports that can be connected to your network devices' serial ports, using the included 6-foot proprietary cables. Once the switch is set up, you can use a dial-up, telnet, or terminal connection to control your network devices. For example, on our tests, we connected two of the ports to two PCs running Symantec's pcAnywhere, and a third port to a 3Com managed hub. Using a single dial-up connection to our review unit, we could remotely control the two PCs and manage the hub simultaneously. This is a great way to save money on multiple phone lines and modems.

Server Technology also offers another version of the Sentry R-2000 without the Windows NT server shut-down feature, which is available for $1,599 (list).

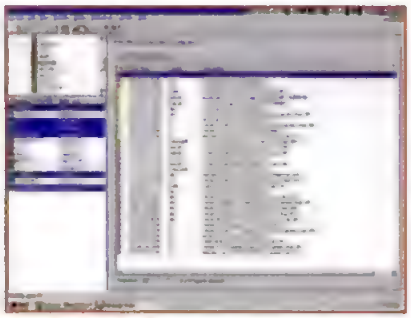
Server Technology Sentry R-2000. List price: Base unit, $2,199; Intelligent Power Module, $60 and up; single-port Ethernet interface card, $600; single-port Ethernet interface card with two serial ports, $800; Any to Any matrix switch, $600. Server Technology Inc., Sunnyvale, CA; 800-835-1515, 408-745-0300; fax, 408-745-0392; www.servertech.com. *Choose 904 at www.pcmag.com/infolink.*

SERVER MANAGEMENT

Getting an Executive Summary

By Steve Rigney

Although Microsoft Windows NT and NetWare both include some basic tools for monitoring your server's health—including CPU, memory, and hard disk information—the tools don't always let you monitor multiple functions at the same time. Seagate Software has developed Manage Exec 5.0 (starting at $895 list per server) to monitor multiple functions and to alert you to problems on over 10,000 Windows NT and NetWare servers, making the information available via a Web server or a Windows-based console utility. You can also send alerts to an SNMP management console or even to an alphanumeric pager. Though we liked the product, we wish that it could go beyond alerting us to problems and let us restart a sick server.



MANAGE EXEC *presents alerts in user-defined priority.*

The Manage Exec monitoring and alerting console runs on a PC based on Windows NT Workstation or Server. If you want to use a browser to monitor the information, you'll also need a Web server. Unfortunately,

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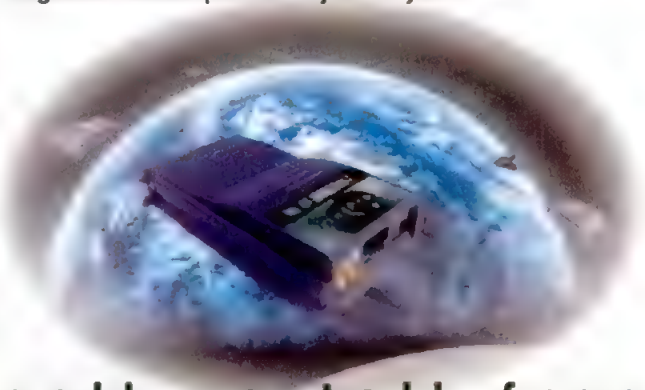

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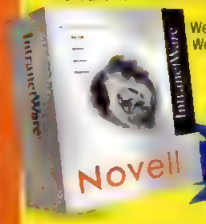

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DEC1474	3Com EtherLink III 10BT ISA 5pk	$269.95
DEC2425	3Com Etherlink III 10BT-10BT2 ISA	$69.95
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DEC3010	Intel 10/100+ PCI 5 Pack	$369.95
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BND2551	Addtron 10/100TX PCI	$27.99*
DEC2255	Kingston 10/100 PCI	$49.99
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DEC2942	3Com Fast Etherlink III 10/100 16Bit PCMCIA	$149.99
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DMD3448	USR 56K* Fax modem* External Mac-V.90	$179.99
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DBN0599	AdvanceStack 208T w/FREE HUB	$719.99*
DEH3341	Intel 510T 24 port 10/100 switch	$2799.99

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DEP1492	HP JetDirect Card 10BT	$309.95
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DEP1584	AXIS150 Print Server Dual Port Multiprotocol	$159.00
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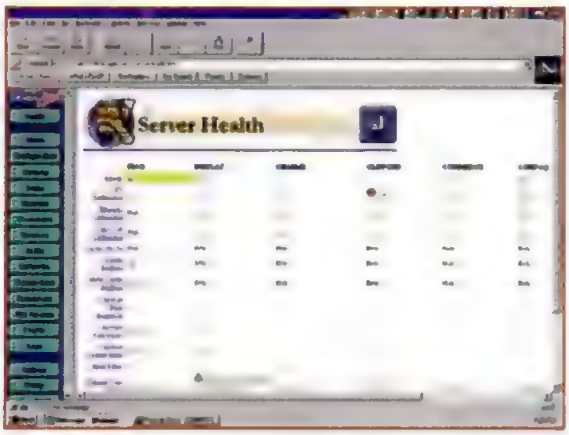
Manage Exec works with only a handful of Web servers—Microsoft IIS, Netscape Fast Track Server, and O'Reilly's WebSite. Monitoring your servers using a Web browser is a handy ability, but you can't perform every task you can perform from the Windows-based utility. We couldn't configure or add new agents, for example.

Installing Manage Exec was pretty painless, but we did encounter one problem with the NetWare client. To monitor a NetWare server, the Windows NT–based management console must connect to the server using Novell's latest NetWare for NT client. After we installed the NetWare client, we couldn't connect to our NetWare server. With help from Seagate's technical support, we resolved this problem by manually installing the client rather than by using the product's installation routine.

Manage Exec agents each run as a service on Windows NT and as an NLM on your NetWare servers. Both agents monitor hundreds of different components. During testing, we monitored NDS cache buffers, the memory pool, CPU utilization, block sizes, and cache information on our NetWare servers. Likewise, Manage Exec provided service, application, CPU, disk, and memory information on our Windows NT machines. Only the NetWare agents can perform baseline monitoring to determine trends. We wish the Windows NT product could do the same.



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Our favorite feature is Manage Exec's ability to set up thresholds that alert you to a problem, so that you view only the data you deem important. We configured the product to send an alert only if the CPU utilization exceeded 80 percent or the disk space fell below 10 percent. Another feature we liked let us set up persistent thresholds, so we were able to configure the product to send an alert only if the CPU utilization maintained a high mark for a long period of time.

LANdesk Server Manager, part of Intel's LANdesk Management Suite, most closely competes with Manage Exec in terms of the alerts and the number of settings monitored. Both products monitor Windows NT and NetWare servers, but LANdesk provides additional features, such as one that reboots PCs and optional network adapters that report each server's temperature and the BIOS version.

Manage Exec 5.0. List price: $895 per single server. Seagate Software, Heathrow, FL; 800-327-2232, 407-531-7501; www.seagate-software.com. *Choose 905 at www.pcmag.com/infolink.*

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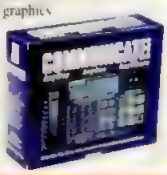

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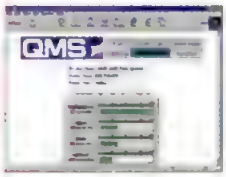

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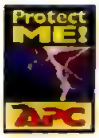

If you've ever installed a 6-20kVA, non-redundant, legacy UPS system in a datacenter, you know the challenges: installation is a struggle, maintenance is a challenge, power upgrades are unheard of, and hardware tends to be unreliable. In fact, most legacy UPSs were designed for electrical and manufacturing applications and not with the needs of today's sensitive datacenters in mind. Worst of all, with a single point of failure, the legacy system is all too interruptible.

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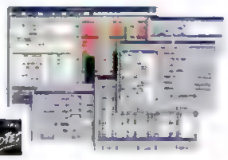

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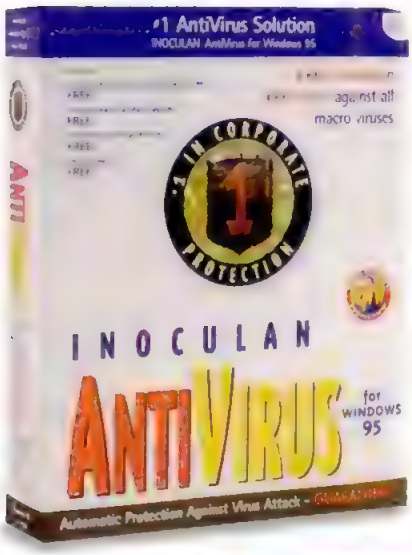

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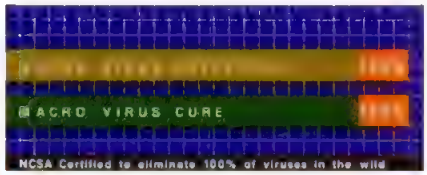

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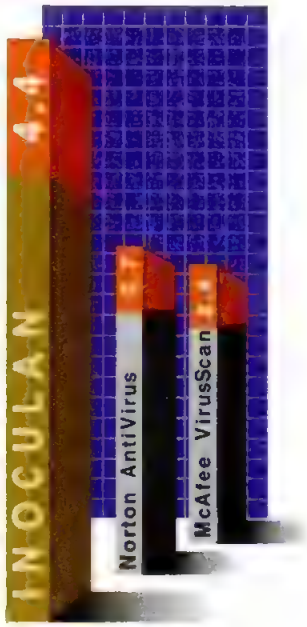

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Net Tools

INTERNET TOOLS

WEB SERVER DATA CONNECTIONS

Rise Above the Static

By Jeff Downey

If there is one constant on the Web, it's that things change. In the recent past, Web servers dished out static HTML files that resided on disk and could be changed only by human intervention. Web server vendors quickly boosted this low-tech solution to include dynamic content. In other words, they made it possible for Web servers to change content on a request-by-request basis, with popular solutions such as Common Gateway Interface (CGI), ISAPI, NSAPI, server-side include (SSI), and more recently Java servlets.

To see how these solutions handled performance and portability concerns, we created a simple dynamic-content application and port it to several dynamic-content environments. To run our tests, we requested the applications from a browser and used a network sniffer to time how long it took for the server to return the data. We found that faster environments required more complex programming.

SSI represents the industry's first attempt to add dynamic information to HTML pages. It works through instructions the HTML developer embeds there. A Web server recognizes and replaces SSI instructions with content, such as "add current date and time here," before sending the page to the end user.

But SSI has many drawbacks. The dynamic content you can add is limited to basic information like date, time, last time modified, and document name. The Web server takes a severe performance penalty, because it has to parse through each file to detect embedded instructions before the file is sent. Fortunately, though, the Web server administrator can tell most Web servers to parse only those files with a certain extension, such as .shtm. The SSI approach is rapidly disappearing from the corporate environment. If your Web site still uses SSI files, they should constitute only a small percentage of your file set.

The real breakthrough in dynamic-content solutions came a few years ago with the definition of the CGI, in which a Web server executes an application rather than reading a static HTML file. The application then generates HTML output for the end user. CGI applications are either executable programs or interpreted scripts such as Perl. A good example of CGI at work is when a search engine is used to seek information on the Web.

A CGI application knows it is going to be executed by a Web server, and it expects the server to provide certain things, like specific environment variables defined in the interface. Environment variables define the Web server and the end user for the application. For instance, the CGI environment variable SERVER_SOFTWARE identifies which Web server software is currently running.

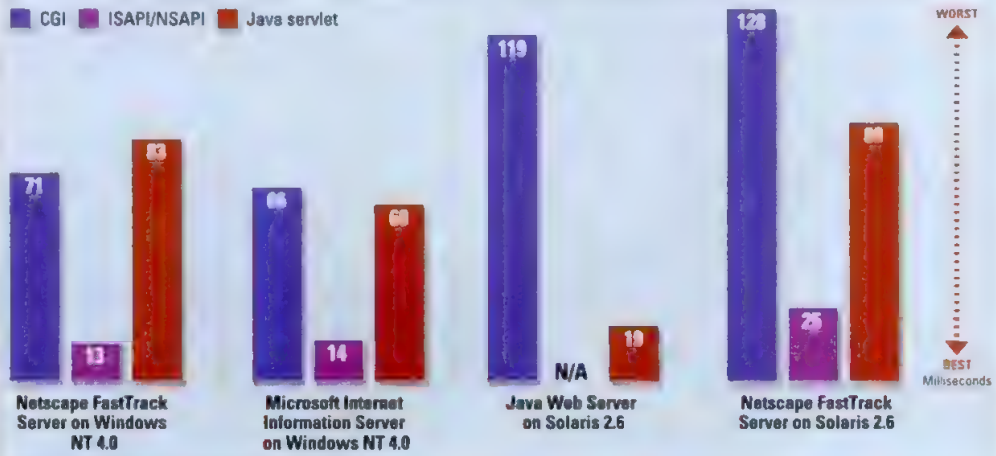
THE SIMPLE APPROACH

In our first attempt to create a dynamic-content application, we developed a simple CGI program written in C. The CGI application reads and sends the names and values of the environment variables to the browser—or automated applications like a Web robot or benchmark program—that requested the data.

Our CGI application was easy to port to different OS environments, because we wrote the program in ANSI C and we kept it simple. Since we had compiled the application under IRIX, OS/2, Solaris, and Windows, we didn't have to change a single line of source code. Porting to the Macintosh environment required a complete rewrite of the code.

There is a significant drawback to using CGI applications as dynamic-content solutions. They are slow compared with other solutions, as was our CGI applet, because each CGI execution requires the OS to set up and tear down a process—a time-consuming set of operations that can cause a bottleneck.

Interface Response To test these interfaces we developed an application and used a browser to request it from the server. We used a network sniffer to time how long it took the server to return the data.



N/A—Not applicable: This product does not use APIs.

ILLUSTRATION BY MARK SHAVER

Web server vendors have gotten around the CGI bottleneck by letting developers write dynamic link libraries (DLLs). These libraries get loaded directly into the Web server's address space. The set-up and tear-down process is replaced by a function call, dramatically increasing performance.

In DLL solutions, each Web server vendor replaces standard CGI with its own native interface. After studying sample applications and reviewing the NSAPI documentation on Netscape's Web site, we could port our CGI application to work with Netscape's native interface. By the way, every Netscape Web server ships with what you need (such as include and make files) to create an NSAPI application. Once things were set up properly on one server, porting to other platforms was painless.

Java servlets are very portable, though they execute slower than the lightning-fast ISAPI and NSAPI.

When you use NSAPI, you don't have access to the standard CGI environment variables. Netscape provides what it considers to be equivalents (minus one-to-one mapping), which are discussed adequately in the NSAPI FAQ file on Netscape's Web site. When we first ported our application to Microsoft's IIS dynamic-content interface, ISAPI, the build environment available to us was similar to Netscape's. It basically consisted of some include files—part of a program's source code, examples, and make files, which generate a computer program from the source code. We could have used ISAPI wizards that Microsoft has recently incorporated with Visual C++ 5.0 to build our computer program from the source code. But our application was so simple we decided to stick with our make file.

Developing an ISAPI application is similar to developing an NSAPI application. Both require you to understand native data structures and functions. Unlike NSAPI, however, ISAPI provides access to CGI environment variables. There are two types of ISAPI applications you can build: server extensions and server filters.

Server extensions are DLLs similar to CGI applications in that the end user directly calls a DLL like *www.acme.com/search.dll*. The first time an ISAPI server .dll extension is called by an incoming request from the Internet, the Web server loads the DLL into memory, where it resides thereafter. ISAPI *server filters* are similar to NSAPI filters, but users don't call the DLL functions directly. Instead, the Web server calls them when certain events, such as server-log writes, occur.

The chart "Interface Response" shows the dramatic speed increase you can achieve by porting your CGI application to a native Web server API. But this speed benefit comes with some drawbacks. For one, applications development is more complicated. It may be difficult to port complex CGI applications. Also, native API code must be reentrant. In other words, a programmer must be aware that multiple threads may execute the same code simultaneously. Thus, when programming a native application, you must make sure that multiple threads aren't stepping on each other's data. One errant native application can crash an entire Web server.

JAVA SERVLETS

Java servlets are meant to be a compromise between the portability of CGI and the speed of native-interface applications. They are very portable, though they execute slower than the lightning-fast ISAPI and NSAPI.

To develop a Java servlet you need the standard Java Development Kit and the Java Servlet Development Kit (JSDK). The JSDK adds two programming classes to your Java development environment. You use these classes to do CGI-based tasks such as obtaining CGI environment variables and writing output to the Web server. Creating a Java servlet from our original CGI application was easy. The final product was a Java class file that a Java Virtual Machine can recognize and interpret. As a result, we achieved the ultimate in portability: We could execute this file on any Web server running on any platform as long as the server supported Java servlets.

Most Web servers do not support Java servlets, so Sun has developed some Web server add-ons to integrate support into three popular servers: Apache, IIS, and Netscape. You can also find third-party add-ons that will provide servlet support. And of course, Sun's Java Web Server ships with native Java servlet support.

The downside to this solution is that Java servlet support is still in its infancy. Many servlet add-ons or the Java Virtual Machine under them broke when we pelted the Web server with multiple simultaneous requests from different physical clients. Sun's Java Web Server had the best performance, because JWS loads the servlets into its address space, as does the ISAPI/NSAPI model. If you decide on a Java servlet solution, give your Web server environment a stress test before it goes live.

Adding dynamic content to your Web server environment involves trade-offs. If you want the speed of an ISAPI/NSAPI solution, then you're going to need top-notch programming talent. CGI programming is easier to do but comes at the cost of Web server performance. Java servlets bridge the gap between complexity and the need for speed yet are still too new to be taken seriously. PC

Comparison of Dynamic Web Interfaces

Choosing the proper interface for adding dynamic content to your Web pages requires trade-offs between performance and portability across Web server platforms, as well as considerations about ease of use.

	SSI	CGI	ISAPI/NSAPI	JAVA SERVLET
Portability	Excellent	Fair	Poor	Good
Performance	Poor	Fair	Excellent	Good
Pros	Easy to use, portable, no programming is needed.	Can use familiar programming environment.	Very fast.	Portable. Uses the JDK environment.
Cons	Very slow, and it displays a limited type of information.	Slow.	Native API. Programming bugs can crash the Web server.	New and unstable.
How it works	The Web server parses the HTML and translates the embedded instructions.	The Web server executes the CGI application as a separate process.	The application is part of the Web server address space.	The Web server uses a Java Virtual Machine with a servlet add-on to interpret the Java applets.

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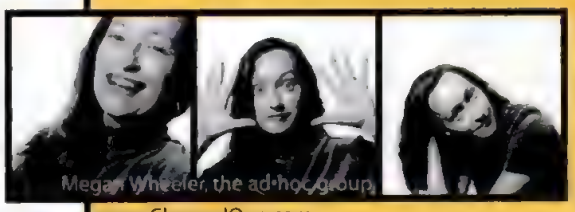

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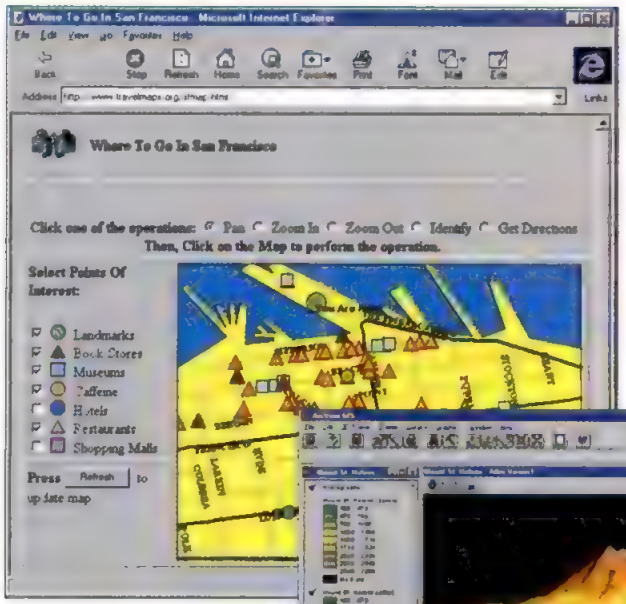

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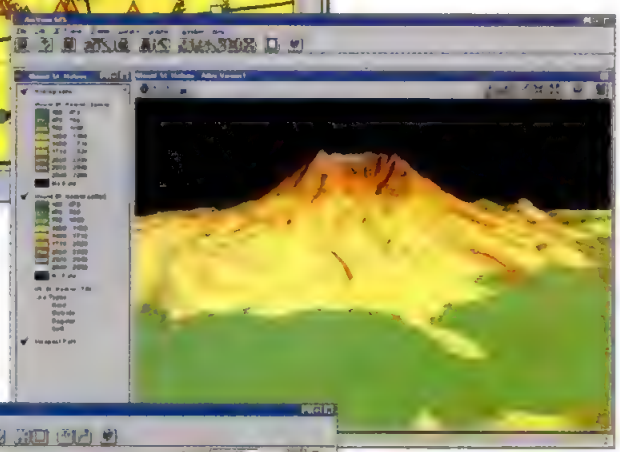

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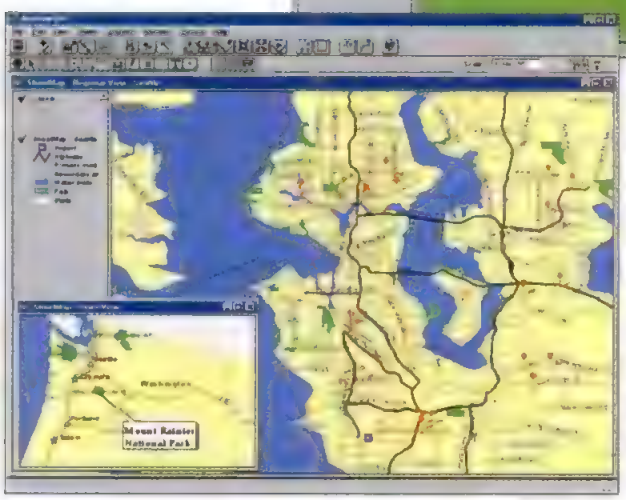

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PC Tech

ILLUSTRATION BY MILAN TRENC

Grids for Visual Basic

Why reinvent the wheel? One of these eight custom controls can make developing your applications much easier.

By Will Fastie

One of the things that makes Microsoft Visual Basic (VB) such an attractive development environment is the huge aftermarket it has spawned. There are, literally, thousands of add-on products for VB, most of which are designed to make the software developer more productive and efficient.

Custom controls (now more generally called ActiveX controls) make up the bulk of these products. Controls are the objects you can place on a VB form, such as buttons and text boxes. Custom controls are those not built into VB itself but that VB can recognize as if they were built in. Custom controls range from simple specialized or enhanced text boxes that are sold for a few dollars to huge subsystems that perform major functions and cost thousands. Custom controls can be identified by their extensions: .VBX for 16-bit VB (Version 4 and earlier) and .OCX for 32-bit VB (Version 4 and later).

Many of the less expensive custom controls, such as those specialized text boxes, aren't very complicated. In fact, it is often simpler to write VB code for standard text boxes than it is to use the controls. A significant advantage of writing the code yourself is that you can make the text box or other control work exactly the way you want, with no compromises. Now that you can build controls using Visual Basic 5.0 (VB5)—which was previously the domain of C/C++ only—it often makes even more sense to build instead of buy.

But not always. There are some commercial products that can make your life much easier, products that are difficult for even expert programmers to construct on their own. An important

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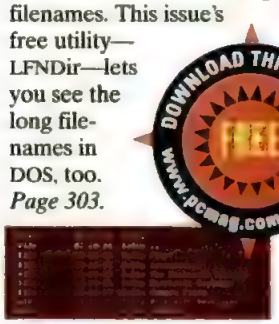
INSIDE

TUTOR: Microsoft is taking it on the chin from the Justice Department for including Internet Explorer in Windows. The debate is about whether IE is actually a part of the operating system. There are arguments for and against IE's inclusion; we look at both sides of the coin. *Page 299.*

UTILITIES: Windows 95 finally freed PC users from the constraints of short filenames. But if you switch to a DOS window the constraint remains! And to make things worse, Windows substitutes cryptic short filenames for long filenames. This issue's free utility—LFNDir—lets you see the long filenames in DOS, too. *Page 303.*



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PC SOLUTIONS: Preventing programs from running automatically at start-up, clearing up the confusion over SCSI standards; inserting pictures in Word 97; removing blank rows from Excel forms; and much more. *Page 307.*

Editors' Choice

• True DBGrid Pro

The market may be the best indicator of which products are the strongest. Apex's True DBGrid Pro and Sheridan's Data Widgets are, respectively, the number-one and number-two products in terms of sales in the Visual Basic market. That's the way we see it, too.

We give a slight edge to True DBGrid Pro because its compatible offspring, DBGrid, comes with VB5. That makes converting existing DBGrids to True DBGrids very easy (and Apex even provides a migration tool to make the task painless). True DBGrid Pro continues Apex's tradition of high performance and includes a comprehensive list of features, so keeping the faith doesn't involve any compromises.

Saying that Apex has a *slight* edge is an enormous compliment to Sheridan. Data Widgets, despite its number-two market position, has not been a particularly strong product in the past. But Version 3.0 departs from that tradition: It's a high-performance, feature-laden product that represents a tremendous improvement over the prior version, with many impressive features and capabilities.

The one downside to both products is that neither binds in VBA. This is a trait they share with most of the products here, however, and so is not damning. For VB5, either grid will serve you well.

example is "data-bound" grids. Because grids are so versatile and useful, they represent a powerful addition to the toolbox of the VB programmer. Grids are, perhaps, the most useful and powerful of all the general-purpose custom controls.

A grid is a means to display information in tabular form, similar to tables in word processors or worksheets in spreadsheets. Grids are thus organized into rows and columns. When connected (bound) to a database, rows usually represent records and columns represent fields in those records. The number of rows displayed depends on the source of the data (for example, an SQL statement as the record source for a bound data control). The number of columns displayed is usually based on the property settings of the grid control itself.

Binding is accomplished by connecting a grid (or any other bindable control) to the VB data control. The data control in turn connects directly to an external data source with its DatabaseName and RecordSource properties. A bindable control connects to a data control via its DataSource property, which is—very simply—set to the data control's name.

We endeavor here to examine and describe a broad set of grid products currently on the market. This is a difficult assignment for several reasons. For one, there is a surprisingly large number of such products available, both commercial and shareware. (A quick search for "grid" on the Web makes that clear.) For another, no two grids are alike. It simply isn't possible to compare the products head to head, because each seems to have a different focus and a different feature set. That means it's very hard to point to one product as the best: You'll have to choose a grid (or maybe more than one) that meets your specific needs or that fits your personal development style. We do have a favorite, but don't simply take our word for it. Make your own evaluation carefully.

To keep the list manageable, we decided to restrict the roundup to products meeting three criteria. First, we only examined commercial products. Grids are complex; we felt that having a commercial enterprise to provide support and update the product over time was very important. Second, we limited ourselves to grids that bind to the VB5 data control without programming (that is, by setting properties at design time). Finally, we had to be able to construct our test case (see below) with the product.

Before looking at the products, take a look at the sidebar "A Brief History of Grids," which discusses how grids evolved in VB and an important limitation in VBA.

GRID TYPES

The presence of versions of True DBGrid and vsFlex in VB5 illustrates the many differences among grids that make comparison so difficult. For example, both grids can be bound to a data control and will automatically display the records specified by data control's recordset. Right away there's a difference. You can edit the data in a DBGrid; the changes you make are automatically written back to the bound database. FlexGrid, the version of vsFlex in VB5, is read-only when it is bound. But FlexGrid is much easier to use when the MSGrid style is desired; DBGrid is more difficult to use in unbound mode, a historical problem. Each grid can perform its own set of tricks—in particular, the user can "pivot" a FlexGrid (reorganize the table by changing the order of columns) by dragging columns with the mouse.

There is no official categorization of grids, and the truth is that the grids are as varied as their vendors. We see three general categories.

•Data navigation. Grids in this category are at their best when bound to a data source. They allow rapid navigation through the recordset, support edits to the data, and automatically write the changes back to the underlying database. The connection between the grid and the data source is very tight, with changes to either reflected immediately in the other. VB5's DBGrid is a data navigation grid.

•Display. Display grids provide endless ways to present their data. Individual cells can contain controls like radio buttons, check boxes, combo boxes, or graphics. Some display grids can work like outline controls, displaying subordinate, related information with a click of the mouse. Most data navigation grids have many display features as well, with more being added in every new version. We don't expect this category to remain distinct much longer. VB5's FlexGrid is a display grid.

•Spreadsheet. The granddaddy of the grid is obviously the spreadsheet. A number of products provide spreadsheetlike functionality for general use within a VB program. Spreadsheet grids are probably on the wane, however, because of the tight integration present in the office suite products and the inclusion of similar features in data navigation grids. Why use a limited spreadsheet grid when you can embed an Excel spreadsheet? FarPoint's Spread product is one of the few remaining spreadsheetlike controls.

The trend is toward data navigation grids with rich display capabilities. We expect the market to move in that direction over the next year or two. For this reason, you should give more attention to those products with the best data navigation features because they will eventually have all the display features as well.

HOW WE TESTED

Because the grid products are so different, our review is necessarily subjective. But because we feel that the data navigation features of grids are the most important, we put the grids to the test by building a browser for a Jet/Access (Jet 3.5/Microsoft Access 97) table of 100,000 name and address records called "Contacts." We generated the table using Datatect 1.1, an excellent product from Banner Software in Sacramento, California (916-364-0900). Datatect generated a suitably random collection of names, addresses, phone numbers, and so forth, giving us confidence

that the data could not skew the tests one way or another. The randomness of the data also tends to make indexes well balanced and again prevents skewing of test results.

We did all the testing with VB5. Because we are most interested in data binding and record navigation, we simply connected each grid to a data control that referenced the Contacts table. Then we got a general impression of performance by watching the following behaviors:

- Initialization. Observing how fast the grid displays when first loaded.
- Paging. Clicking the scroll bar to move the grid down one page at a time for several pages.
- Move to end. Dragging the scroll bar's thumb to the end of the scroll bar to display the last record in the table.
- Return to beginning. Dragging the thumb back to the top of the scroll bar to return to the first record immediately after the move-to-end test.

You might guess that record navigation performance would be a function of the data control, not the grid. That's true in the sense that record navigation can't be any faster than the data control allows. We used the same data control configured in the same way for all grids, however, so any differences in performance between the grids are a function of the grids themselves.

We didn't use a stopwatch or timer for these tests. If grids appeared to perform about the same, we considered them the same. This amounts to a pass/fail situation: If the grid was fast it passed, and if it was slow it failed. In the reviews below, we mention the slow grids; when there is no mention of performance, the grids were acceptably fast or better.

All tests were performed on a 200-MHz Pentium Pro machine with 32MB of RAM. All data access was from local IDE hard disks.

Sheridan Software Systems Inc.

Data Widgets

Sheridan wins the prize for having the most improved product, version to version. Data Widgets 2.0 was good enough to garner a number-two position in the market, but that was due more to Sheridan's excellent reputation as a VB add-on vendor than it was to the quality of the product. Third time's the charm: Data Widgets 3.0 (DW) is an excellent product.

First and foremost, DW's data navigation performance has improved dramatically and is on a par with the better products here. It fell short only on the return-to-beginning test: DW took longer than most grids to return to the first record after having navigated to the last.

Sheridan has always focused on the display capabilities of its grid. This version of DW is no different, offering some of the best capabilities around, with very attractive presentation (Figure 1). Buttons, check boxes, pictures, or pictures with text can be configured in any cell. DW includes five other controls to enhance cells: DataCombo, DataDropDown, DataOptionSet (radio buttons), DataCommand (buttons to activate database functions), and the Enhanced Data Control. These controls can be used in conjunction with the grid or as standalone controls in your project. By default, DW's grid even looks the nicest, automatically alternating the background color between adjacent records even when no other display features are enabled (this feature is easy to disable if you don't want it).

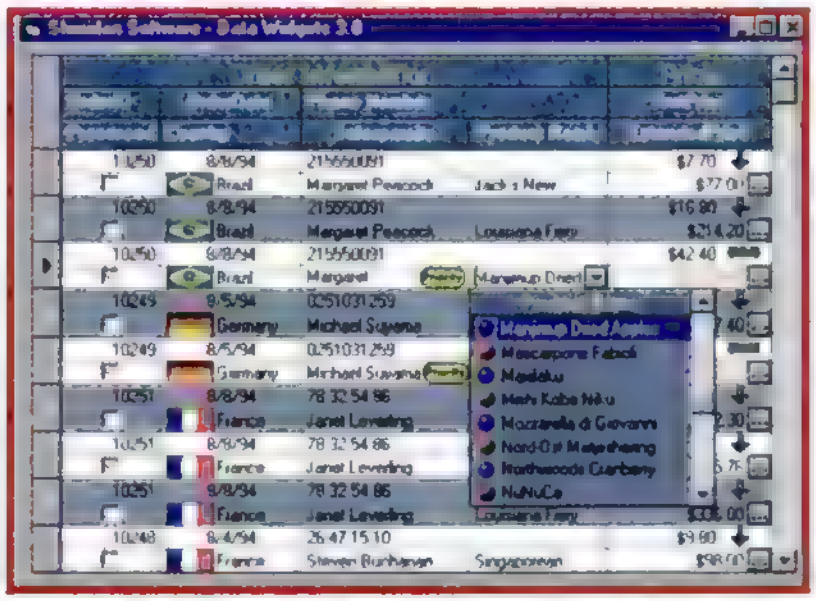

FIGURE 1: *Data Widgets has impressive and attractive display capabilities—an emphasis of the product.*

The Enhanced Data Control (EDC) is not a replacement for VB's data control but rather a front end for it. It includes an extensive array of buttons for functions like `find`, `find next`, `find previous`, `set bookmark`, `goto bookmark`, `add record`, and more. Most programmers don't use the VB data control as a visual component in applications because it is sparse; the EDC might change some minds.

For DW 3.0, Sheridan put considerable energy into enabling the grid control for use with Web applications and providing automatic HTML export so the grid's contents can be used as a Web display page. Sheridan is emphasizing the grid's ability to publish to a printer, a file, or HTML, capabilities richer than those offered by most competing products.

We were disappointed to note the elimination of the printed manual from Data Widgets. Although this is understandable given the increasing use of electronic distribution for software components, DW is still intended for a developer market that tends to like hard-copy documents. DW is the only grid product from a VB vendor without a manual. (It's interesting to note that none of the C/C++ products came with a printed manual.)

Sheridan's reputation and the great improvements offered by Version 3.0 make Data Widgets an attractive product that will no doubt serve to heat up competition in the category even more.

Data Widgets 3.0. List price: $295; introductory price, $269; upgrade from previous version, $129. Sheridan Software Systems Inc., Melville, NY; 800-823-4732, 516-753-0985; fax, 516-753-3661; www.shersoft.com. *Choose 528 at www.pcmag.com/infolink.*

Sybase Inc.

dbComplete

dbComplete is a very powerful grid, perhaps the most powerful in our roundup. The product comes from a division of Sybase that was formerly a standalone company, Visual Components (Vcomp), one of the earlier VB custom control vendors. Despite VComp's VB heritage and the fact that the product is, indeed, targeted at the VB developer, dbComplete is not for the faint of heart.

The dbComplete package includes the data outline grid and a suite of custom databound controls. The controls include a masked edit box, combo box, picture combo, calendar combo (very nice), option group, and check box. There is also a data control. Unlike Sheridan's enhanced data control, the VComp data control not a front end but a replacement for the VB data control. Standard VB controls that support data binding can also use the VComp data control. dbComplete *must* use its own data control; it will not work with VBs.

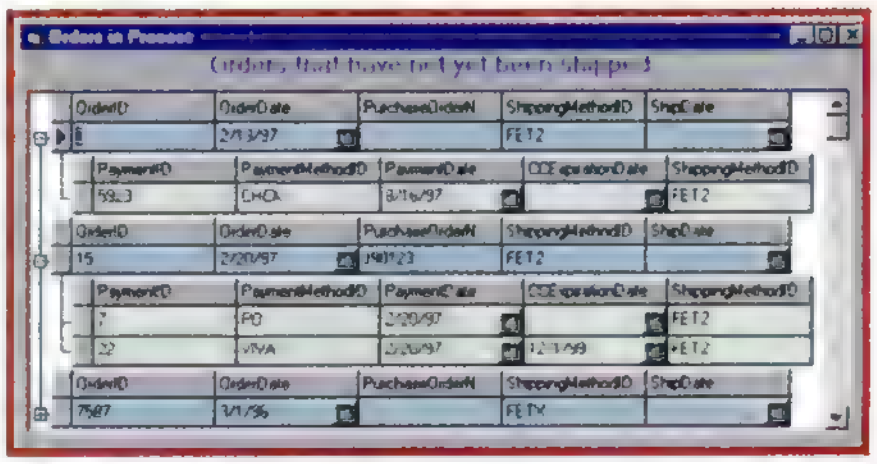

FIGURE 2: *dbComplete's powerful outline data grid enables the display of related information from multiple tables.*

The grid itself is very impressive. As shown in Figure 2, it can display data from multiple tables in an outline fashion, with related records from a related table appearing under their parent. Using dbComplete's

Grid Designer, such grids can be designed with relative ease, although the process is tedious because Grid Designer is not visual. Grid cells can contain any ActiveX control, a very powerful capability. In Figure 2, note that dbComplete's own calendar combo is used in all the date fields. Even though VComp provides a data control, the grid can get at an ODBC data source by itself, without an attached data control.

The bad news is that dbComplete and its data control can connect only to ODBC (Open Database Connectivity) data sources. Even when using a Jet/Microsoft Access database, dbComplete must go through ODBC drivers. Sybase considers this a plus because its interest is in the client/server market, and dbComplete is an excellent choice for this kind of work. But ODBC drivers can be slow, and the ODBC drivers for Jet/Access, even the updated ones provided by Sybase and Microsoft, *are* slow. dbComplete's performance suffers because of this; our navigation tests revealed sluggish performance.

Sybase also offers Visual Components Suite, which incorporates dbComplete. For an additional $100, you'll receive First Impression (a charting component), Formula One (Vcomp's original spreadsheet grid product), and Visual Speller (an add-in spell-checker) along with the grid. If you're interested in dbComplete, you'll find the bundle a bargain.

We don't recommend dbComplete as a browser for Jet/Access databases. Do, however, take a serious look if the mission is client/server, you understand ODBC and SQL well, or you only intend to display small recordsets (such as query results).

dbComplete 1.5. List price: $299; with Visual Components Suite, $399. Sybase Inc. (Visual Components Division), Overland Park, KS; 800-771-1645, 913-851-2200; fax, 913-851-1390; www.visualcomp.com. *Choose 529 at www.pcmag.com/infolink.*

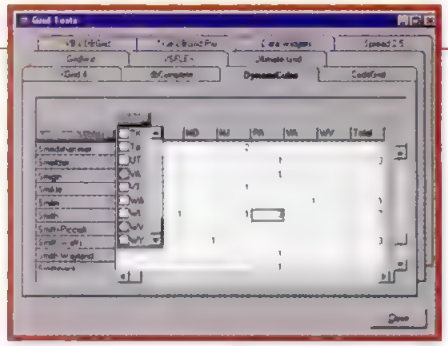

FIGURE 3: *Not a true grid, DynamiCube is a powerful and flexible pivot table control.*

Data Dynamics Ltd.

DynamiCube

DynamiCube 2.0 does not quite fit the mold of the other grids in this review. In fact, calling it a grid is generous. It is a special-purpose tool intended for professional developers. At its special purpose, however, it excels.

DynamiCube is not designed to display tabular records. Instead, the product summarizes data from a recordset by presenting it in

A Brief History of Grids

The first versions of VB shipped with very few controls, most of which were hard-coded into VB. Microsoft was smart enough to realize that by itself it could not meet the needs of the huge mass of programmers it hoped to attract to VB, so it also built into VB the ability to connect to controls written by others. This let the company look at the aftermarket and decide which add-on features were most interesting to VB programmers, then add similar features to subsequent versions of VB to support that interest. Grids began to appear almost immediately.

The Microsoft Grid control (MSGrid) first appeared in a VB add-on product called the Pro Pack that shipped after VB1 was released and then became part of VB2. MSGrid is a very basic grid that *cannot* be bound to a data source. Everything about the grid has to be coded by hand, including populating it with data. Limitations on the capacity of MSGrid mean even more programming work for large data sources. MSGrid, in a 32-bit version, is still available in VB5 but the documentation makes it clear that it is obsolete, included only for backward compatibility.

For VB4, Microsoft went to Apex Software Corp., makers of the popular and powerful TrueGrid Pro for VB3, to get the DBGrid control. The original DBGrid was a bit buggy, but Apex endeared itself to VBers by quickly releasing a free upgrade to a repaired and, as it turned out, significantly enhanced version called True DBGrid Standard Edition.

VB5 saw even more grid action. In addition to providing an improved DBGrid, Microsoft went to yet another outside vendor and included MSFlexGrid, from Videosoft. Microsoft's willingness to include third-party grids reflects the VB market's interest in them. We now have a market in full flourish, with dozens of options.

Though VB4 and VB5 include DBGrid and other bound data controls, as well as bindable standard controls (like text boxes), VBA (as delivered with Microsoft Office) does not. That's because such controls need to bind to a data control, which VBA also does not include. Unfortunately, this makes using most of the grid products with VBA difficult. They must be used in *unbound mode*, meaning that the programmer must write all the code to populate them with data. Most of the grids support unbound mode, but working this way is complicated, even for an experienced programmer. That's really too bad; since VBA appeals to a wide audience, you'd think Microsoft would make everything as simple as possible.

The last bit of history divides grid controls into two camps, by language. Over the years, separate grids have been available to VB developers and to C/C++ developers. A grid from one camp typically was not marketed to or used by the other. The transition from VB extensions (.VBX) to ActiveX controls (.OCX) changed this; now vendors from both camps market over the line. This is especially true of vendors from the C/C++ camp, who now covet the much larger VB market.

There are subtle differences in the products, depending on the camp. C/C++ developers tend to be more technically sophisticated, so vendors in this market often don't take as much care with help files and documentation. C/C++ products can sometimes be a bit cryptic, but most C/C++ developers can usually figure them out quickly. Also, C/C++ developers tend to use class libraries, so packaged custom controls are relatively new to many of them. Vendors in the VB market are just the opposite, having always dealt with packaged controls in a broader, slightly less technical market.

One advantage of grids from the C/C++ camp is that there is often a way to bind to data sources without the data control. That's because C/C++ tools don't usually provide a data control. As a result, using such grids with VBA is simpler than using unbound grids. Isn't it funny that the C/C++ grid vendors are providing a solution that the VB grid vendors have yet to offer?

Nonetheless, we recommend that VB developers first evaluate products from the vendors whose main historical focus has been the VB market.

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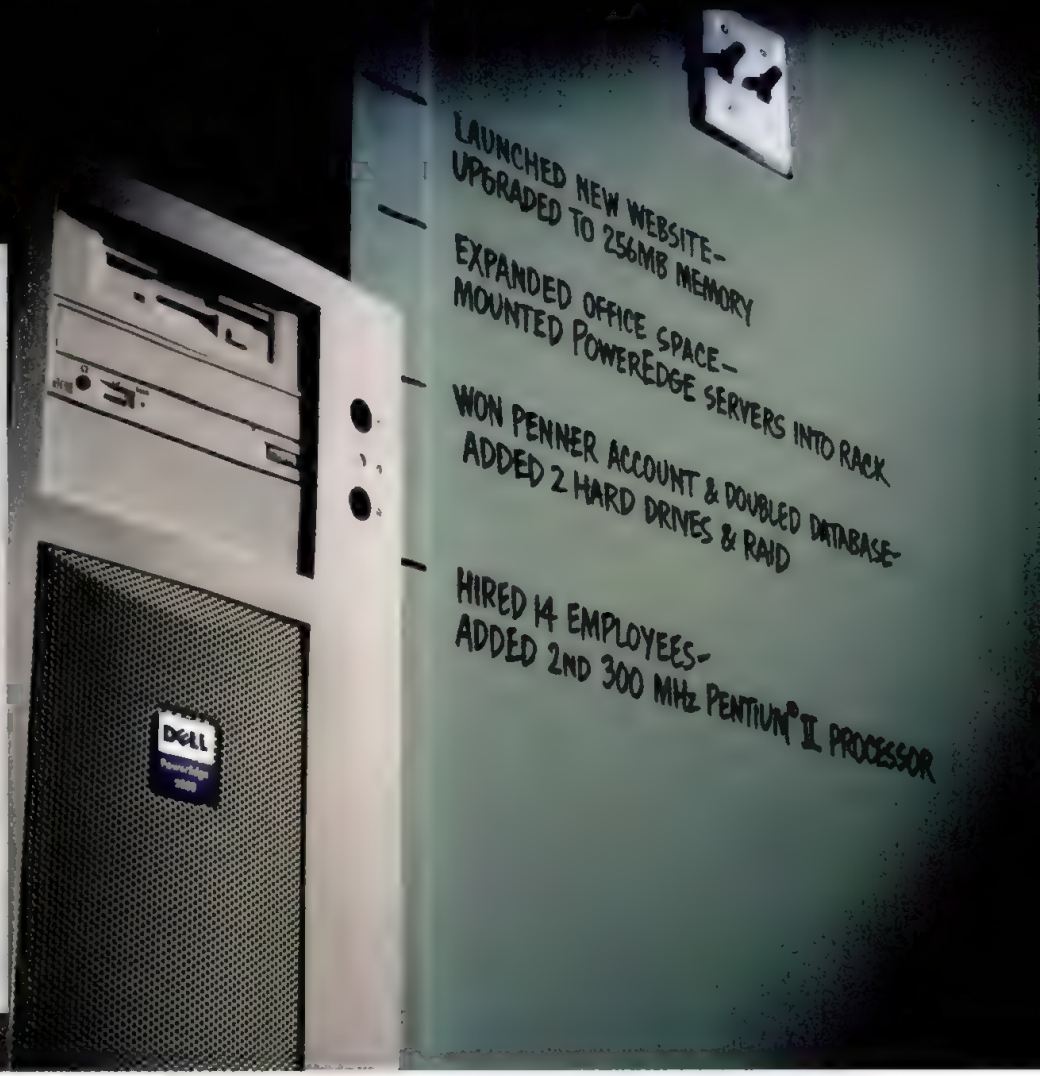

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cross-tabular fashion. For example, you can define a "cube" that shows products in rows and unit sales for those product by regions in columns. Ordinary crosstabs are usually two-dimensional, useful for cases like the products and regions of the previous example. But DynamiCube is a multidimensional crosstab that can organize the summarized results based on many more than two categories.

Figure 3 shows a simple crosstab we devised from our test table. We built a cube that showed the count of each last name by state, then used the runtime filtering feature to reduce the number of states to just the few that surround Washington, D.C. This was incredibly easy. We could also have written a SQL query to select only the states we were interested in to begin with. More complex cubes require some thinking and perhaps some experimentation, but they aren't particularly difficult. This simple example does not show the product at its best and it does not demonstrate all the features available to the end user, so get more detail if you think the product might be helpful to you.

DynamiCube can take some time to load data and build the crosstab, but once it has the data in hand all the end-user operations are blindingly fast. Despite interesting features and great speed, the product comes on a single floppy disk, a sure sign of thoughtful development.

DynamiCube is a very creative, tremendously interesting product. It's also a bit expensive and has a particularly restrictive (and somewhat obnoxious) license agreement. It isn't designed for record navigation, the focus of our review. Developers who use DynamiCube will surely keep another grid in their arsenal for more general use.

DynamiCube 2.0. List price: $499. Data Dynamics Ltd., Columbus, OH; 614-895-3142; fax, 614-899-2943; www.datadynamics.com. *Choose 530 at www.pcmag.com/infolink.*

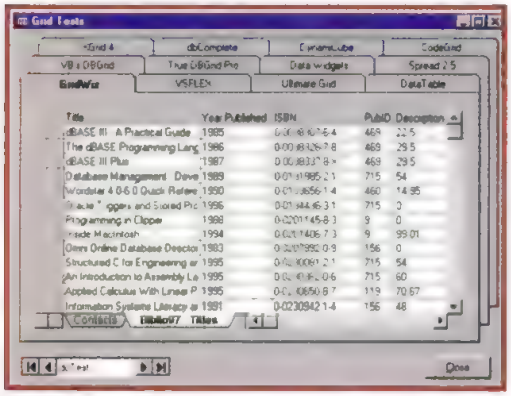

FIGURE 4: *GridWiz is unique in its ability to display grids with multiple tabs. Each tab can have its own data source.*

McRae Software International Inc.

GridWiz OCX

We had high hopes for GridWiz OCX because it has some interesting techniques for connecting to a database without the need for the data control, making it usable in the VBA environment. Unfortunately, GridWiz isn't ready for prime time.

GridWiz comes from a C/C++ developer that has not made a clean transition to the VB market. The GridWiz control is a bit more complicated to grasp than other controls in the category. For example, most of the grids have a DataSource property. Because GridWiz doesn't need the data control, that property doesn't exist. But no other properties for database access are evident in VB's property inspector, a point of immediate confusion. It turns out that those properties show up when you launch the GridWiz Grid Workshop, McRae Software's visual grid-designer applet.

Grid Workshop sounds good, but it turns out to be rather limited. Most other grid products offer the same features without having to launch a separate program. Grid Workshop's awkward user interface can make it a rather confusing program, and the Workshop itself was the source of several crashes while we were testing it; it's not a product for the casual developer.

One interesting and powerful feature of GridWiz is its ability to create and display a tabbed worksheet, the way many spreadsheet products do. In Figure 4 you can see how we were able to display both our Contacts test table and the Titles table from the ubiquitous Microsoft example database, Biblio, in the same grid.

GridWiz doesn't offer any of the display attributes of other grids and has below-average data navigation performance. There's an extensive array of example programs, but they are awkward and would serve the company's interests better if they were integrated into a comprehensive demo.

More polish is needed before the product will make progress in this competitive market category, but GridWiz's tabbed sheet feature is a strong selling point.

GridWiz OCX 3.54. List price: $149. McRae Software International Inc., Chagrin Falls, OH; 216-543-9242; fax, 216-543-9242; www.mcraesoft.com. *Choose 531 at www.pcmag.com/infolink.*

FarPoint Technologies Inc.

Spread

Spread, one of the original grid products, is the only product in this roundup that will work with very old versions of VB. Although this might be of interest to some programmers, the bulk of VB developers work with either the most current version or the version that preceded it. The very fact that Spread still works with VB2 dates the product.

Spread has one of the best grid designers of any product we tested (see Figure 5). It is very visual, enabling very rapid formatting of the grid. It should serve as a model for the other products in this category. Its only flaw is that the default styles, such as fonts, are those used for Windows 3.1. The Windows 95/Windows NT developer must adjust these settings to match contemporary standards.

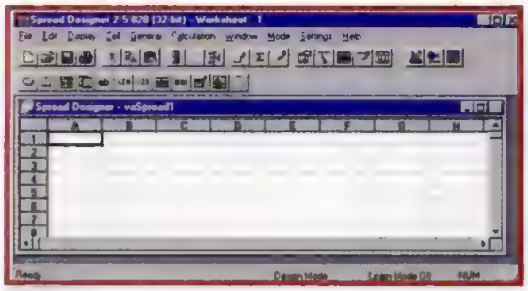

FIGURE 5: *Spread doesn't have much to recommend it, but other grid vendors could take a page from FarPoint's book on grid-design tools.*

It was easy to construct our test browser, but Spread fell far short on our record navigation test: It performed abysmally. Given the product's poor performance, the inclusion of many of Spread's spreadsheet features in other grids, and Spread's high price (for a dated product), we suggest looking elsewhere.

Spread 2.5. List price: $299. FarPoint Technologies Inc., Morrisville, NC; 800-645-5913, 919-460-4551; fax, 919-460-7606; www.fpoint.com. *Choose 532 at www.pcmag.com/infolink.*

Apex Software Corp.

True DBGrid Pro

PC MAGAZINE EDITORS' CHOICE

True DBGrid is the market leader in the grid category, and deservedly so. From the original, VB3-based product, TrueGrid Pro, to today's much richer version, Apex's grid has always had the perfect mix of excellent performance, a competitive set of features, and an above-average manual. It has taken years for the other VB product vendors to build grids that match True DBGrid's performance. Performance is the most likely reason Microsoft chose

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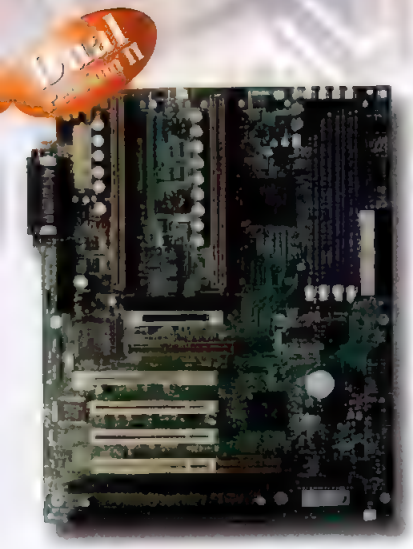

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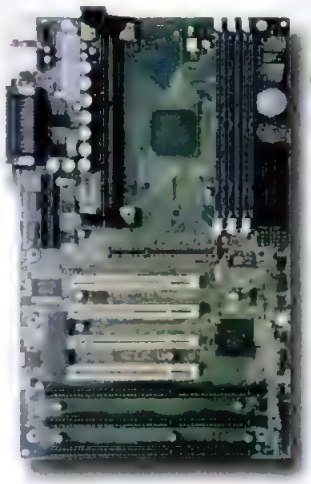

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Apex to supply VB's DBGrid control.

True DBGrid is not the flashiest grid on the market in terms of its display capabilities. It does have the expected ability to display grid cells with check boxes or radio buttons, pictures, text and pictures together, or a data-aware drop-down list box (a separate control included with the package). It can display cells in a data-sensitive manner, such as placing a red background in numeric cells whose value matches a supplied criterion (such as being negative). Cells can be formatted in many supplied ways and can also be formatted using an arbitrary VB format string.

FIGURE 6: *True Browser is an excellent example of how True DBGrid Pro yields a powerful yet flexible database browser with minimal programming effort.*

More advanced formatting includes the ability to split the grid into as many sections as you wish, each of which scrolls independently. You can display records on a single row or on multiple rows. And you can set records apart by highlighting alternate records with a different background color.

What True DBGrid may lack in flash it more than makes up for with its industrial-strength data capabilities. The product came into life designed for record-navigation tasks; display capabilities came later. Its data capabilities make it one of the simplest grids of all to use.

On the side of simplicity, all you need to make a very capable table browser is a data control and a grid, linked together. The skilled VBer can build such a browser from start to finish in about 2 minutes; the resulting grid loads the table quickly, provides rapid navigation, and allows edits to be saved to the database. A few extra minutes and mouse clicks will yield an even more powerful grid that allows records to be deleted and added. Apex supplies a demonstration program called True Browser (Figure 6) that does this and more; it is relatively easy for even the novice to comprehend.

Designing more complex data-bound grids isn't particularly complex, but as with most products here the process is somewhat tedious, involving repetitive changes on property sheets. True DBGrid does suffer from the lack of a visual grid designer that would relieve the tedium. Version 5.0 includes a VB add-in called Design Assistant, but this simply presents properties in a way that allows them to be set for more than one column at a time.

The toughest side of True DBGrid comes when the grid is not bound. There are three other modes: *storage mode,* which uses a virtual storage object called an Xarray; *application mode,* which fires events on a cell-by-cell basis to retrieve cell data as needed for display; and *unbound mode,* which fires events to retrieve data for a row or group of rows. Unbound mode, perhaps the most complicated of all the modes, has gotten a face-lift in True DBGrid Pro 5.0 and is somewhat easier to handle. All these modes require programming and all involve some complexity. The benefit of this complexity is performance; if you can handle the programming, you will obtain a good result.

Another improvement in Version 5.0 is a completely reworked manual, the best ever. Its organization is improved, there are more graphics and examples, and the writing is clearer. A number of other grid products have moved to electronic documentation; Apex has resisted this temptation so far.

For data access and navigation, True DBGrid Pro remains the best product in its class. Those seeking the fanciest display options will have to look elsewhere, but in that case they should expect to sacrifice some performance.

True DBGrid Pro 5.0. List price: $299.95; upgrade from Version 4.0, $149.95; upgrade from VB4 or VB5, $249.95. Apex Software Corp., Pittsburgh; 800-858-2739, 412-681-4343; fax, 412-681-4384; www.apexsc.com. *Choose 533 at www.pcmag.com/infolink.*

Videosoft

vsFlex

Like Apex, Videosoft benefits by having a "lite" version of its vsFlex product included in the box with VB5: MSFlexGrid. As noted in the main body of this article, FlexGrid is the de facto replacement for the original MSGrid and is thus intended for use primarily in unbound mode. It's read-only when bound, a severe limitation. vsFlex 3.0's vsFlexArray control has no such limitations, however; when bound, it is completely editable.

Videosoft products have traditionally emphasized improving the developer's ability to present data attractively and with a minimum of programming. vsFlexArray is no exception. Its name comes from its support for pivot tables, a function it performs very well. Figure 7 shows a before-and-after example of a vsFlexArray pivot table; both screenshot fragments were snapped from the same grid, with the bottom showing the result of dragging columns to new locations to provide a new view of the same data. The manual includes a simple and very clear example of constructing a pivot table.

For record navigation, the performance of vsFlexArray when used with our 100,000-record test file was on a par with that of the better products. The vsFlex documentation, however, warns about grids of over 5,000 records when pivoting is the objective; that's an understandable and reasonable warning, because the data must be loaded into memory to make pivoting perform well. Connecting a vsFlexArray to a data control to construct our test proved a bit more complicated than with most grids. Once the grid's DataSource property was set, it was necessary to set several additional properties to obtain our desired behavior. When you know how, it's simple enough—but we fumbled a bit before we got it right.

vsFlexArray does not have as many cell-formatting options as other products here. That will tend to limit the appeal of this otherwise good grid to those interested in upgrading from MSFlexGrid, those who need only a basic grid, and those in need of pivot capabilities. Videosoft is a particularly creative company in the VB add-on business, with a portfolio of unique and interesting products, so we expect vsFlex to become more interesting and full-featured as time goes on.

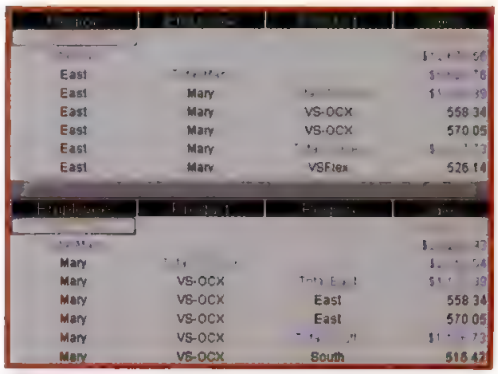

FIGURE 7: *VSFLEX's ability to pivot tables makes it a great choice for end-user, decision-support applications.*

Check Videosoft's Web site: The company is one of the most aggressive when it comes to fixes and minor enhancements. You can download a trial version of vsFlex and fire up the excellent demo program—something else Videosoft does well. The

demo will also show you how vsFlex integrates with another Videosoft product, vsView, a printing and print preview control. If you have both controls, it takes only a single line of code to print a vsFlexArray.

vsFlex 3.0 (Build 036). List price: $249; upgrade from Version 2.0, $129; upgrade from Version 1.0, $198. Videosoft, Emeryville, CA; 800-228-4839, 510-595-2400; fax, 510-595-2424; www.videosoft.com. *Choose 534 at www.pcmag.com/infolink.*

GreenTree Technologies Inc.

XGrid

GreenTree is a well-known vendor in the C/C++ market whose product line is well regarded. The company's entry in the VB grid category, XGrid, has one distinguishing characteristic: It's fast.

XGrid had the best responsiveness on our record-navigation test. The fact that XGrid beat the market leaders led us to examine our move-to-end test more closely. The test was defined as dragging the thumb on the grid's vertical scrollbar. It's also possible to move to end by clicking on the button furthest to the right on the linked data control. What we noted about XGrid was that it was the only product that behaved identically regardless of which move-to-end technique we used. In other words, both methods were fast. With other products we discovered a difference; clicking on the data control was usually the faster method. What this means is that the synchronization between XGrid and the data control is better than that of any other grid.

XGrid is one of the easiest grids to understand and use, perhaps because its feature set is limited. It can handle any data task well, but its display capabilities are a bit spartan. This may not matter to some developers, but it puts XGrid at a disadvantage when the product is compared with the market leaders.

On the other hand, there's the price. XGrid's list price is the lowest in our roundup—a rock-bottom $99—and a bargain considering the performance. Hopefully, GreenTree will work to make the product more competitive with the rest of the products in this roundup. Until then, XGrid is the clear choice for the economy-minded.

XGrid 4.0. List price: $99. GreenTree Technologies Inc., Huntington Station, NY; 800-257-7708, 516-271-6995; fax, 516-271-8067; www.green-tree.com. *Choose 535 at www.pcmag.com/infolink.* PC

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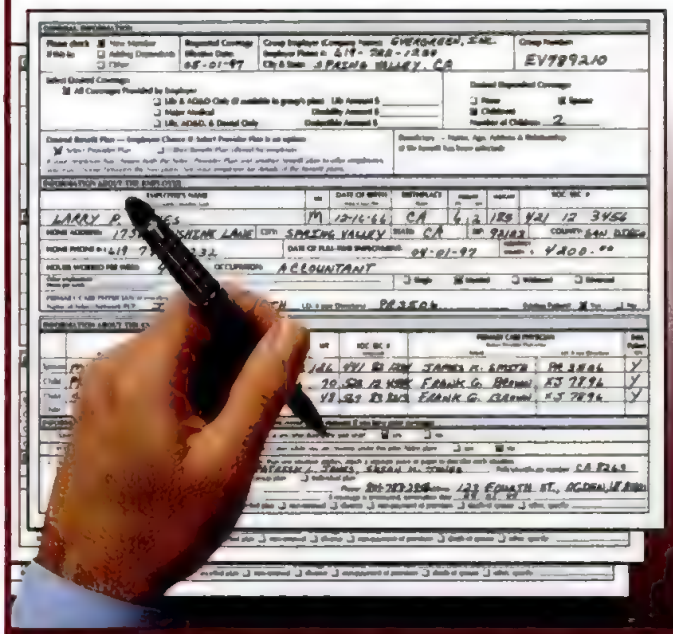

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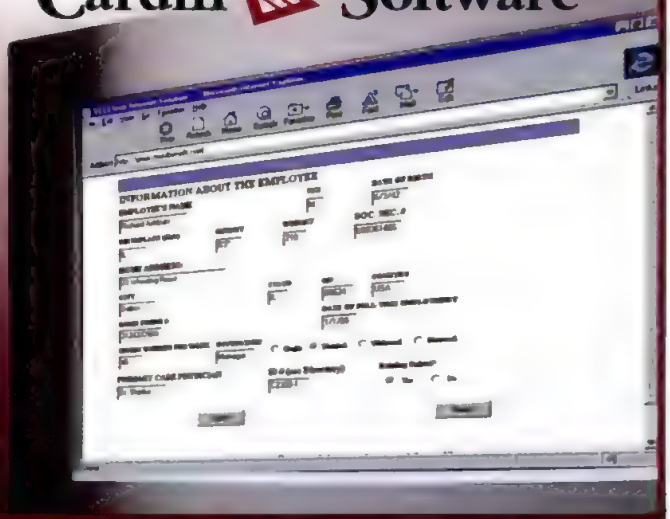

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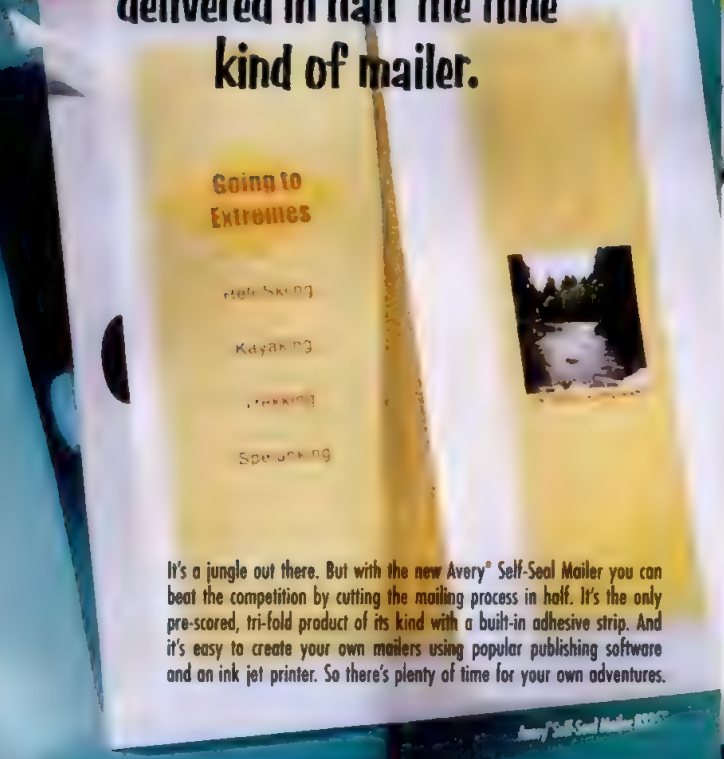

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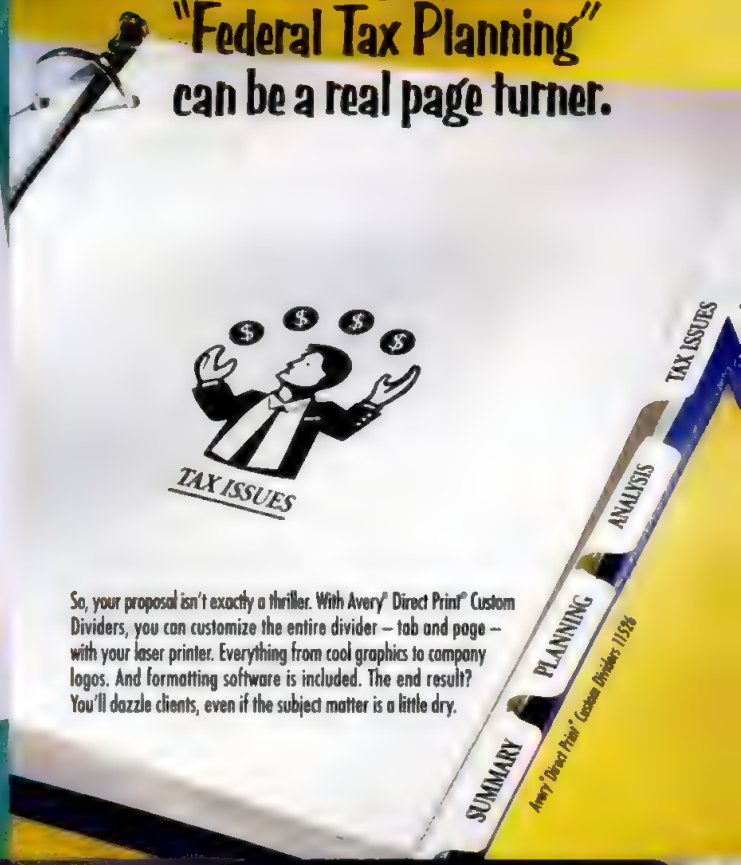

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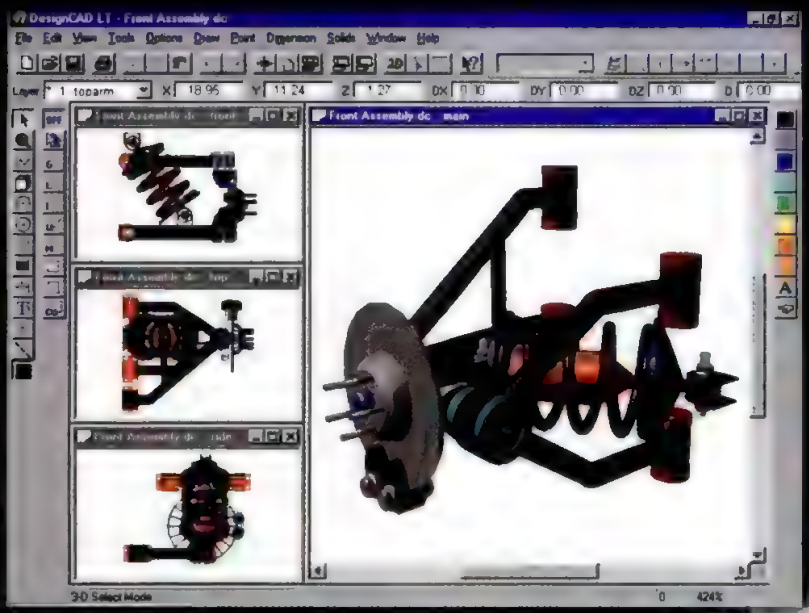

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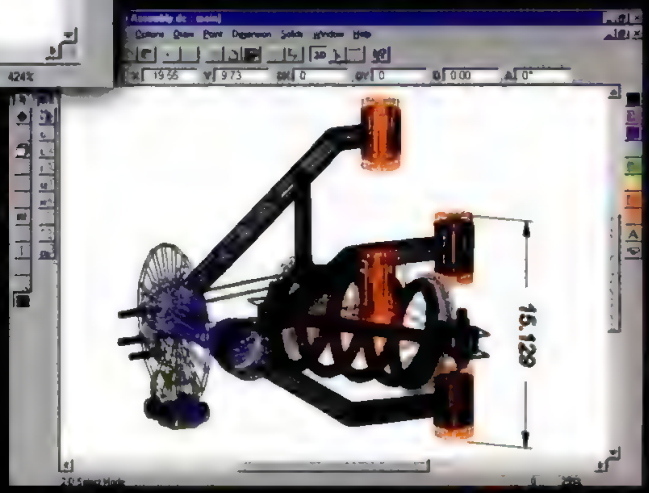

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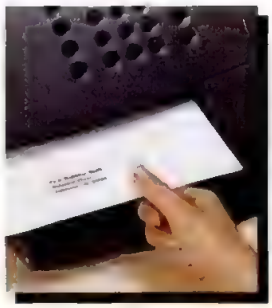

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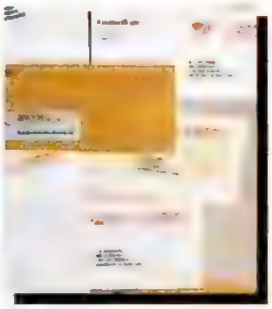

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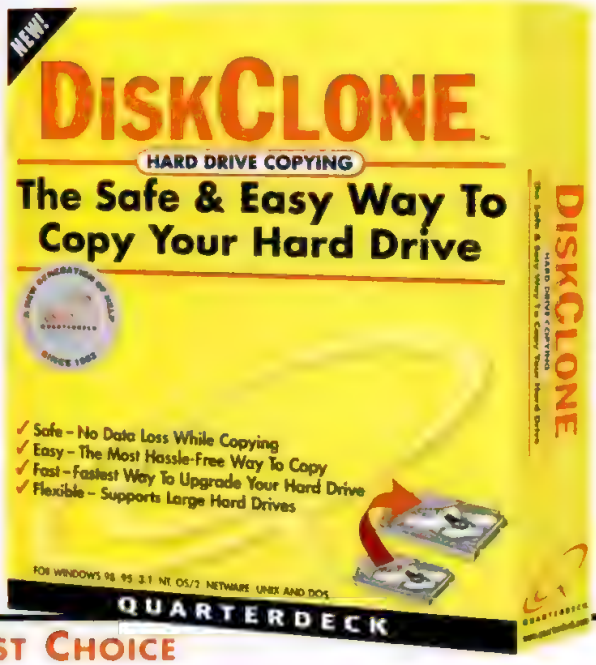

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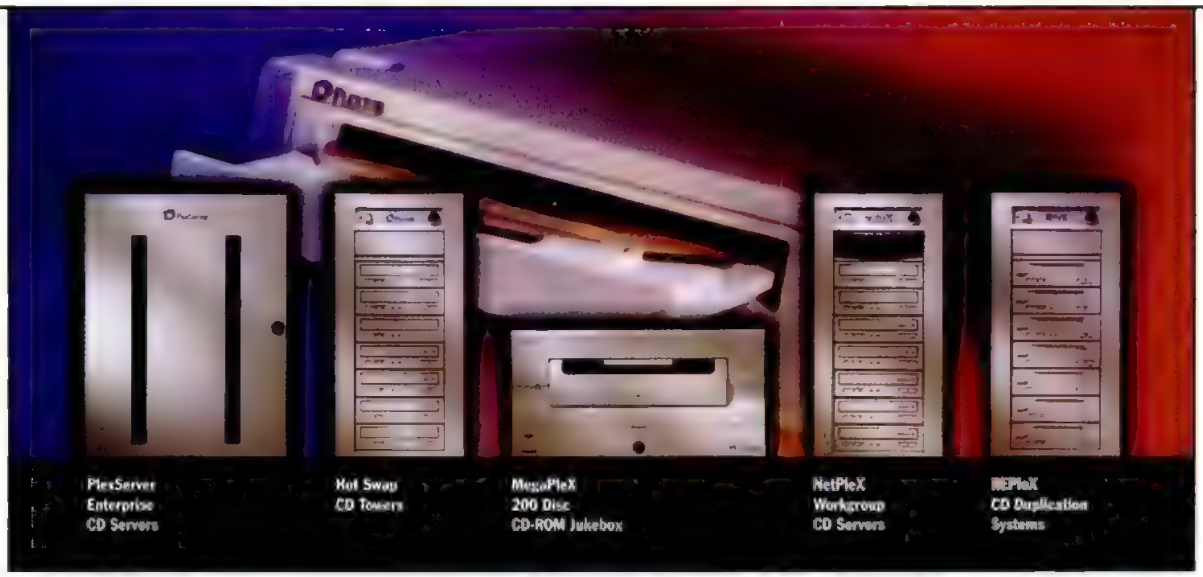

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So What's an Operating System, Anyway?

We all think we know what constitutes an operating system. But do we really?

By Neil Randall

At the heart of Microsoft's reputation in the computer industry, and the troubles the company has been having with the Department of Justice, is the definition of the term *operating system.* Long before the current brouhaha over Microsoft's insistence that Internet Explorer 4.0 must be part of Win 95 and Win 98 and thus must be included and installed with every system that contains Win 95 or Win 98, competitors were already claiming that Microsoft should be split up into an OS division and an applications division. Allowing the apps and OS groups to work together, the argument went, gave Microsoft an unfair advantage in developing the best word processors, spreadsheets, database programs, and so on. After all, the applications group had direct access to all the OS's secrets.

The argument made sense. It was only natural for Microsoft to take advantage of an intimate knowledge of the operating system—complete with undocumented items—to make apps that tapped *all* the OS's features, even if the competition couldn't do quite as well. But it was also (arguably) unethical, because there was no real way for the competition to—well—compete. Of course, you could always argue that the other software companies could build their own operating systems and try to take Microsoft's market, but free-market economics always seems to get lost in the shuffle in this discussion.

The current dispute over whether or not Internet Explorer 4.0 is part of the operating system is more interesting from a technical standpoint. There's no question that IE 4 spreads throughout Win 95 as soon as it is installed, and it's embedded in Win 98 from the start. Every system window (Control Panel, My Computer, Windows Explorer, for instance) in the Win 98 interface is a browser, and from any of these windows you can browse not only the Web but your LAN and your local hard disk as well. If you're examining your C:\Windows directory in My Computer, for example, and you want to check for a possible video-driver upgrade on the Internet, there's no need to fire up a separate program. Just type the URL in the *Address* box and away you go. The button bar and menus even change to reflect your new activity.

So is IE 4 part of the operating system, or isn't it? That's the question. And the answer is far from easy, despite Microsoft's assertions that "of course it is" and the non-Microsoft contingent's claims that "of course it isn't." At stake is a broader question: What is an operating system? In particular, what elements that are added to an operating system can rightly be considered integral parts of it? And beyond this question lies another one: What do users *believe* to be part of the operating system? These are key issues in the ongoing discussions about Microsoft and its OSs.

THE OPERATING SYSTEM

As its name suggests, the operating system is the software that operates your PC. The operating system isn't the most basic software your machine uses—that honor goes to the BIOS—but it's the most basic system most users pay much attention to (Figure 1). The operating system acts on the one hand as traffic manager, controlling the flow of data around your PC and starting and stopping processes, and on the other hand as a means through which software can access the hardware and system software. In fact, the operating system goes one step further, giving users a facility for issuing commands to the system software. This facility is called the user interface. The other common interfaces, already alluded to, are the hardware interface and the programming interface.

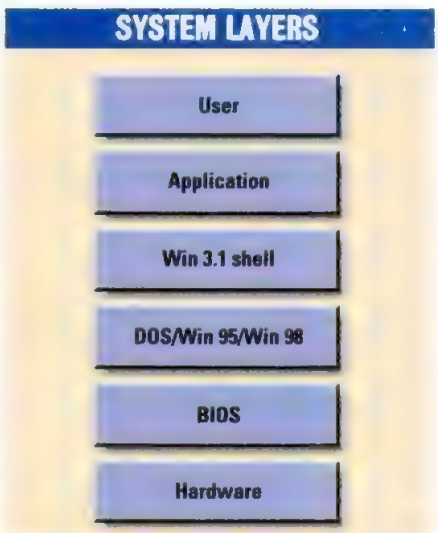

FIGURE 1: *The layers between you and your system's hardware.*

One of the most fundamental tasks of the operating system is controlling disk access and storage. Indeed, the names of early PC operating systems contained the acronym DOS, for *disk operating system.* These included MS-DOS (Microsoft), PC-DOS (IBM), DR-DOS (Digital Research), AppleDOS (the pre-Macintosh Apple), and AmigaDOS (for the Commodore Amiga). The disk basis of the name is still implied in the term *NOS* (network operating system); the NOS controls the workings of the network. But the operating system has never been simply about disk access and storage; from the beginning, it has controlled system processes and program task management as well.

Unix people speak of the operating system as having three main parts: the *kernel,* the *shell,* and the *file system.* While DOS/Windows users tend not to use the term *kernel* and only sometimes to use *shell,* the terms are quite relevant nevertheless. The kernel is the low-level core of the operating system and is loaded into memory whenever you boot your system, right after the loading of the BIOS. The DOS/Win 95/Win 98/Win NT kernel handles the transfer of data among the various parts of the system, such as from hard disk to RAM to CPU, and it also assigns memory to the various system-level processes that occur whenever your computer does anything. The kernel is also responsible for scheduling the CPU's operations and for letting the shell access the CPU.

The shell is the visible user interface to the operating system and is, in essence, a program that loads on top of the operating system and offers users commands that let them access the OS. In the Unix world a number of shells are available, among them the Bourne shell, the Korn shell, the C shell, and the Bourne Again shell (honest!). Unix users tend to develop a near-passion for their shell of choice, and they fully exploit its potential to customize their working environments, create their own aliases for frequently used commands, and write scripts to execute programs automatically.

In DOS, the standard shell was COMMAND.COM, again nothing more than a program. Different versions of COMMAND.COM came with different versions of DOS, and each added new commands and new things users could do. For example, DOS 4's COMMAND

.COM added the /P switch to DEL to verify each deletion, and DOS 5's COMMAND.COM provided the ability to sort the output of the DIR command.

Other renditions of COMMAND.COM were available—NDOS and 4DOS, among others—but MS-DOS's COMMAND.COM was, and is, far and away the best known.

Strictly speaking, we've already ranged beyond the operating system here. The shell is simply an input utility that offers access to the operating system, and it is not really part of the OS at all. But over the course of computing history, the shell and other programs have become identified with the OS, and this is where the confusion lies, a point we'll get to shortly. If we want to look at the basic Microsoft operating system DOS/Windows itself, we need look no further than two system files, Io.sys and (in DOS 6.*x* and earlier) Msdos.sys. Both files are crucial in DOS versions up to 6.22 and thus Windows 3.*x* as well (which isn't really an operating system, but rather a DOS overlay), while Windows 95 with its associated DOS 7 combines the functionality of the two into Io.sys. In DOS 6.22 and earlier, Io.sys represents the lowest level of the interface and comes the closest to talking to hardware directly. Io.sys contains the routines necessary for interfacing the OS with the system's BIOS, as well as for accessing the CPU's memory registers. Msdos.sys handles higher-level routines such as file manipulation, converting commands from applications into instructions for Io.sys.

Io.sys for DOS 7/Win 95 is different from Io.sys for DOS/Win 3.*x*, essentially eliminating the need for DOS's two configuration files, Config.sys and Autoexec.bat. Win 95/98's Io.sys loads the files Himem.sys (for access to the high-memory area), Ifshlp.sys (the device-driver loader), and Dblspace.bin or Drvspace.bin (disk-compression utilities). Also included with the Io.sys loading are old Config.sys options such as the FILES, STACKS, BUFFERS, and SHELL commands. Again, this suggests that items that were once options—such as DriveSpace and DoubleSpace—are now, because of their inclusion in Io.sys, built into the OS. Msdos.sys is also different in its Win 95 and Win 98 versions; it contains information about boot options and file locations, including where to find the Windows registry.

Both of these files are in the root directory, and both are hidden from view by default in Windows Explorer (and File Manager) and DOS's DIR command. The idea is that you're not supposed to see them, so that you don't do anything destructive to them (such as deleting them). They're also read-only, so you can't delete them accidentally, but it's entirely possible to highlight them with other files and click *Yes* when asked if you're sure you want to delete. Been there, done that.

(Of course, there's an argument to be made that only a truly idiotic OS would let you delete its critical system files while the OS was running. Windows NT won't let you do so, at least not if it's installed on the Windows NT File System: You can't erase the system files while Windows NT is running, and you can't format or FDISK the root drive. With DOS/Win 95, as soon as you display your system files, you can happily obliterate them, after which your OS won't start.)

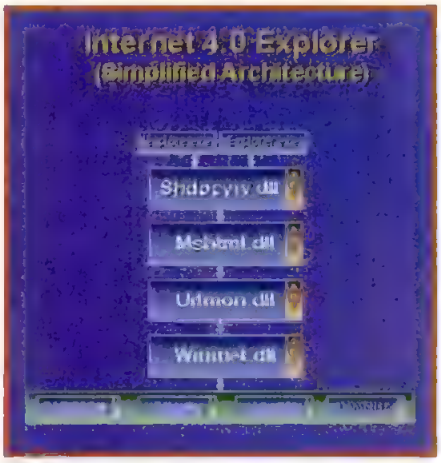

FIGURE 2: *Microsoft's representation of the IE 4 architecture; the tenth element is the OLE/DCOM layer, vital for program interoperability.*

A couple of other points need to be made before we go on. Today's OSs offer a kind of buffer between the application and hardware layers. This buffer is called the *application programming interface* (API), and it gives programmers a means of calling preset common procedures or procedures that demand specific hardware routines. The API is updated as new hardware becomes available, but even this isn't enough. To communicate properly with hardware, the OS uses *drivers,* written specifically to allow communication between the OS and particular pieces of hardware (a video card, for example). Actually, Win 95 adds a second driver layer—the virtual driver—which acts as an interface between an application that calls for, say, a sound to be played and the driver for the specific sound card that resides in that system.

A good example of how the API can be updated in a way that fundamentally changes the OS is the addition of DirectX to Win 95. It doesn't ship with the product, but it now provides the technical underpinning for a wide range of Win 95–based graphics applications.

UTILITIES AND ADD-ONS

The operating system proper might indeed consist primarily of a couple of system files and the shell that offers user access, but over the years an increasing number of pieces have found their way into what users *perceive* to be the OS. We've already mentioned one example: disk-compression utilities. Originally offered by third-party vendors only (Stacker and XtraDrive were two of these products), by the early nineties compression was built right in. Indeed, Microsoft bought Stacker and incorporated the package into its own DoubleSpace. Similar additions have included defragmentation utilities—again, once offered only by third-party vendors, such as Norton and Symantec (which also offered replacement shells for Windows 3.1). To see the kinds of utilities that have been added to the basic Win 95 and (even more so) Win 98 environments, click *Start* | *Programs* | *Accessories* | *System Tools* and have a look. Here you'll find everything from ScanDisk through System Monitor, all of which are considered part of the OS because (a) they do system-level tasks and (b) they ship with the OS itself.

In fact, that's become a fairly common user perception: Whatever ships with the operating system is part of the operating system. It's not true in a technical sense, but arguing against it is a bit like saying that the exhaust system isn't actually part of your car. True, the car can get along just fine without it, but it's part of the car when you buy it, you're usually bound legally to have it, and without it your car is much less comfortable to drive, so it's perceived as being part of the car. The same holds true for a utility like ScanDisk: You don't need it, but it ships with DOS and Win 95/98, and by default Win 98 systems (and Win 95 OSR2 systems) start it at boot time whenever Windows was not shut down properly on last use, so in effect the utility has *become* part of the OS.

Microsoft itself got into the add-on utilities game with the release, early in Win 95's existence, of Power Toys and Kernel Toys (see *www.microsoft.com/windows95/info/shareware.htm*) and extended that move to the downloadable components of Win 95 OSR2 (see *www.microsoft.com/windows/pr/win95osr.htm*). Power Toys includes a number of enhancements to the Win 95 user interface, such as the ability to change screen resolutions on the fly, while Kernel Toys offers new utilities that operate at an even lower level. These include a utility for remapping the keyboard, another for watching your CPU's processes, another for tracking system memory, and still another for customizing elements of the user interface. In

other words, more and more *appears* to be getting added to the OS itself.

INTERNET EXPLORER 4.0

This notion of apparent additions to the operating system lies at the heart of the controversy surrounding IE 4. The question, of course, is whether or not the browser is part of the operating system. To see Microsoft's legal argument about the degree to which IE 4 has been integrated into Win 95, see its sworn court statement at *www.microsoft.com/corpinfo/11-10Cole.html#P45*. Essentially, Microsoft claims that beginning with Version 4.0, Internet Explorer is *part* of the operating system and that removing it will cause the operating system to "break," at least in part. The sworn statement claims that Microsoft engineered both IE 3 and IE 4 as sets "of core Windows 95 system services." These services do more than just offer browser capabilities, and indeed, according to the statement, Win 95 calls on these services and "will not function fully without them." In other words, they're effectively part of the operating system.

According to Microsoft, IE 4 contains nine components that interoperate for full functionality (see Figure 2). These components include five DLLs—Wininet.dll, Urlmon.dll, Mshtml.dll, Shdocvw.dll, and Comctl32.dll—along with two executable files, Explorer.exe and Iexplore.exe, and a security and a Java virtual machine component. Both IE 3 and IE 4 require these DLLs to function and without them could not offer the displays we expect and the features we expect, nor access the Internet at all. Wininet.dll offers Internet services and capabilities, including HTTP and FTP access, modem dialing, and browser caching. Urlmon.dll lets developers treat URLs as if they were programmable objects and thus build them into their applications (Microsoft's own Office 97 does this). Mshtml.dll is the component that lets you view your folders as Web pages: Choose a disk drive from My Computer, for example, and what you see is Dynamic HTML, Microsoft-style, relying on this particular DLL. Shdocvw.dll (Shell Document View) lets developers build browser capabilities into software, while Comctl32.dll (Common Controls) provides low-level support for menus, toolbars, progress bars, and many other controls used across Windows applications.

As for the rest, Explorer.exe replaces the original Windows Explorer, working with Shell Document View to offer a Web interface (for example, allowing you to type a URL, LAN machine name, or local-drive letter in the *Address* field). Iexplore.exe is effectively the program that launches the browser, but the browser requires Shdocvw.dll to operate. The security module offers support for the SSL (Secure Sockets Layer) standard, and the Java virtual machine allows Java apps and applets to run according to the Java specifications.

In the Memorandum and Order of December 11, 1997, *operating system software* is defined as "the set of instructions, codes, and ancillary information that controls the operation of a Personal Computer system and manages the Interaction between the computer's memory and attached devices such as keyboard, display screens, disk drives, and printers" (Final Judgment, Section 14). By this definition, IE 4 seems to exist at a level slightly above the operating system proper. But DLLs, which Microsoft claims to be crucial to the operation of Win 95 beginning with OSR2, tend to be considered OS-level. Furthermore, if you consider the interface for viewing drive contents as a major component of the user's interface to the OS (as DOS's DIR command was for many people), then Win 95/IE 4's shell should be so considered as well. Finally, if we extend the OS to include the *networked* OS, and if we consider Internet access to be part of a network OS, then Wininet.dll alone suggests an OS-level addition.

AND THE VERDICT?

By the strictest definition, IE 4 does not seem to be an integral part of the Win 95/98 operating system. But the strictest definition isn't the most useful definition here. Most users consider external commands such as DELTREE, XCOPY, and ScanDisk to be part of DOS itself, although they're nothing more than utilities that ship with the OS. Similarly, Win 95 ships with a wide range of external programs, ranging from its own ScanDisk through Disk Defragmenter, and most users consider those part of the OS. One of those high-level programs, the browser we call Internet Explorer, now affects so many other aspects of Windows that it seems inevitable that we lump the program with the OS, and once we do that the discussion is largely over.

Ironically, Microsoft might have saved itself a great deal of agony by simply dumping the name Internet Explorer and just calling the whole thing Windows Explorer, or just Microsoft Explorer. In attempting to capitalize on the term "Internet" and yet build OS functions into its browser, it confused a whole lot of people—and its user interface, in the process. PC

Neil Randall is the author of The Soul of the Internet *(ITCP) and* Special Edition Using Microsoft FrontPage98 *(Que).*

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An Antidote to Aliases

LFNDir displays long filenames under DOS, instead of cryptic aliases containing tildes.

By Rick Knoblaugh

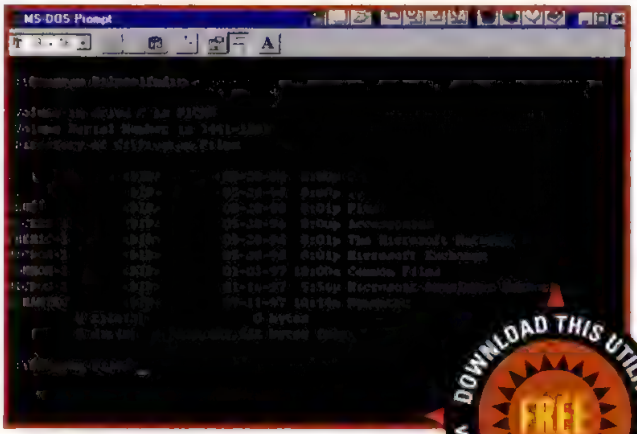
After years of our enduring the cryptic constraints of DOS-style filenames, the long-filename support introduced with Windows 95 is a welcome relief. You can now name a report First-Quarter Earnings.doc instead of 1STQTRER.DOC. But if you boot from a start-up disk or restart your system in DOS mode, the descriptive long filenames are replaced by odd-looking "aliases" that conform to DOS filename constraints. Your report file will appear as FIRSTQ~1.DOC.

This occurs because Windows 95, with its supporting cast of virtual device drivers, isn't loaded. Without these drivers—particularly the installable file system manager (IFSMgr), which contains the heart of the system's long-filename support—long filenames appear not to exist. They're still on the disk, but DOS knows nothing about them and ignores their existence.

Ordinarily, you'll have no reason to boot to DOS and look at your hard disk. But it may be the only way to access and retrieve files from a hard disk that's going south. There are few things more frustrating than being unable to see long filenames when you urgently need to make copies of critical files. This issue's utility, LFNDir, is a command line program that lets you view long filenames under DOS. The syntax and output for LFNDir closely match those of the DOS DIR command when DIR is executed from within a Windows 95 DOS box. You'll still need to use the alias to copy or delete a file, but at least you'll know which alias corresponds to the file you're after!

You can obtain LFNDir for free by download from PC Magazine Online or by mail. Refer to the sidebar "How to Get the Files" for details. The source code for LFNDir, which was written in C, is also provided for those interested in seeing how it works. LFNDir can be used under DOS or within a Windows 95 DOS box. Also, if a removable disk is written under Windows 95 and then taken to a DOS platform, LFNDir can assist in deciphering the disk contents.

LFNDir supports all DOS disk formats. The new FAT32 disk format introduced with Windows 95B (OEM Service Release 2) is not supported.



LFNDIR *is a command line program that lets you view long filenames under DOS. Its syntax is almost identical to the DOS DIR command, and its output looks like what you get when you issue a DIR command in a Windows 95 DOS box.*

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USING LFNDIR

To install the program, copy the file LFNDir.exe to a directory in your path (for example, the Windows Command directory). The syntax for LFNDir is shown in Figure 1. If LFNDir's options seem familiar, it's because they closely mirror those used with the DOS DIR command. The only relevant DIR options not implemented by LFNDir are /S (recurse subdirectories) and /O (sort). I decided to omit both of these options to make things simpler.

As with the DIR command, if you simply type LFNDir on the command line with no parameters, the utility will list the files in the current directory. Alternatively, you can specify a drive letter, a path, or a filename (long or DOS-style). If you use a long filename with embedded spaces, you must place it in double quotes—for example, LFNDir "file with spaces in name.txt." LFNDir supports the wildcards * and ?. As with DIR, you can enter only one file specification on the command line.

LFNDir improves on the DIR command by allowing you to use wildcard characters in specifying pathnames. This can save a lot of typing. For example, to list the files in the C:\Program Files\Accessories\HyperTerminal directory, you can use this command:

```
LFNDir c:\pro*\acc*\hyp*\*.*
```

You can use wildcards right up to the last path element. At the end of the file specification, the wildcards are interpreted just as they are with the DIR command. Some examples will help clarify. If you have a directory called Programs and you enter the parameter c:\pro*, the directory entry itself will be listed—not the files within it. To see the files in the directory, you'd enter the parameter pro**.*. If the directory name contains an extension, you must supply the actual extension or a wildcard. For example, if you're looking for files in the directory Programs.pcm, you would need to enter the parameter pro*.**.* or pro*.pcm*.*.

LFNDir will replace each wildcard directory name with the first matching directory that it finds. Since this may not be the one you want, be sure to type a sufficient portion of the directory name before using the asterisk.

For Programmers Only LFNDir is a 16-bit command line program that lets you view Windows 95 long filenames under DOS. It was written in C. LFNDir's source code is available on *PC Magazine*'s Web site (*www.pcmag.com*) and demonstrates several interesting programming techniques, including how to

- determine the layout of a disk;
- directly access directory and FAT sectors;
- and retrieve long filenames.

Support Help for *PC Magazine*'s free utilities can be obtained in our online discussion areas, both on the World Wide Web (*www.pcmag.com/discuss.htm*) and on ZDNet in the Utilities section of ZDNet's Tips Forum (GO ZNT:TIPS). The authors of current utilities generally visit this forum daily. You may find an answer to your question simply by reading the messages posted in the forum. If the author is not available and the forum sysops can't answer your question, the Utilities column editor, who also checks this forum each day, will contact the author for you.

TIPS AND TRICKS

LFNDir lets you view long filenames under DOS, but to copy or delete files you must use the native DOS commands. Still, LFNDir can help. Specifying aliases for a large number of files can be made much easier by using LFNDir's output to create a batch file. Execute LFNDir in the usual way, but instead of viewing its output on the screen, redirect it to a file with an extension of .bat. For example:

```
LFNDir c:*.* > docopy.bat
```

Next, read the file into your favorite text editor. Using the descriptive long filenames included in the listing, identify the files that you wish to copy. Delete the entries in the listing for the files you won't be copying, and also delete all of the long filenames and time/date and size information, leaving only the aliases for the desired files. Then, using your editor's copy and paste commands, insert the DOS COPY command in front of the alias for each file you wish to copy, and insert a destination for the COPY command at the end of each line. Save the batch file to disk. When you execute the batch file, the files will be copied. Note that the long filenames will not be copied, since the DOS COPY command is not aware of them.

```
LFNDir [drive:][path][filename] [/P] [/A[[:]attributes]] [/B] [/L]

where:

[drive:][path][filename]
Specifies the drive, directory, and/or files to list.

/P    Pauses after each screenful of information.

/A    Displays files with specified attributes:
      D  Directories    R  Read-only files
      H  Hidden files   A  Files ready for archiving
      S  System files   -  Prefix meaning not

/B      Uses bare format (no heading information or summary.)

/L      Uses lowercase for displaying aliases.
```

FIGURE 1: *The LFNDir command syntax is displayed when you use the /? option.*

INSIDE LFNDIR

Under normal circumstances, it's a simple task to obtain the names of all the files that match a given file specification. You pass the file specification to the relevant DOS functions, and DOS takes care of the rest. It transparently navigates the directories and FAT (file allocation table) as it locates each directory in the specified path, and then it identifies the matching files. LFNDir has to do all this without the benefit of those handy DOS functions, and not surprisingly, this takes a large amount of work.

The first step is to determine the layout of the disk, including the location of the first root-directory sector, the number of FAT sectors, and the sector where the first cluster begins. LFNDir then reads the root-directory entries, seeking the one that defines the first directory in the desired path.

When this directory entry is found, LFNDir extracts the starting-cluster number and begins reading the directory entries, seeking a match for the second directory on the desired path. If it gets through the first cluster without a match, it consults the FAT to locate the next cluster belonging to the current subdirectory. When it finds the directory entry corresponding to the next directory on the desired path, it repeats the process.

Eventually LFNDir locates the starting cluster of the last directory in the desired path. At this point, it reads all the directory entries as before, but this time it seeks matches for the desired file specification. For each found file specification, it extracts both the DOS-style filename and, if present, the long filename.

Since LFNDir must access disk sectors directly, it must use its own intimate knowledge of directory structures and the FAT to find its way to the desired files. Let's take a look at some of these file system structures before delving too far inside LFNDir.

THE FAT STRUCTURE

Under the 12-bit and 16-bit FAT file systems, each disk has a fixed number of root-directory entries. (The FAT32 file system doesn't have this limitation.) These are located in the sectors that immediately follow the FAT sectors. Typically, there are two copies of the FAT stored here to provide an extra measure of protection against data loss. Each 512-byte sector in the root directory can hold 16 32-byte directory entries. Each directory entry contains the filename, file extension, attribute byte, and other basic information (see Figure 2).

Subdirectories also use this format, but the number of subdirectory sectors is not fixed. Space is allocated dynamically for subdirectories, just as it is for data files. When a subdirectory is created, a corresponding entry in the parent directory is generated with an attribute-byte value that differentiates the subdirectory from data files.

The starting-cluster number in the DOS directory-entry structure is an index into the FAT, and it indicates where on the disk the file begins. Each entry in the FAT, which is simply a linked list of allocated data, represents a cluster of data on the disk. One cluster is the smallest allocation unit used by the system. Even if a file contains only 1 byte, it will consume an entire cluster on the disk. Clusters are composed of 1 to 64 sectors, depending on the disk size—the smaller the disk, the smaller the number of sectors per cluster. The number of sectors per cluster is always a power of 2.

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Each in-use entry in the FAT either contains a link to the next cluster allocated for a given file, or indicates that the allocation chain for the file ends with that particular cluster. Depending on the disk size, FAT entries occupy either 12 bits or 16 bits. Disks with fewer than 4,087 clusters use FAT12; otherwise, disks use FAT16. The new FAT32 file system uses 32-bit entries and can support disks as large as 2 terabytes. Under FAT12 and FAT16, the FAT is always located in the sectors that immediately follow the disk's boot record. Under FAT32, the FAT location isn't fixed.

The layout of the long-filename directory entries is also shown in Figure 2. The attribute byte, which is in the same place in both structures, enables long filenames to coexist with DOS directory structures. Windows 95 places long filenames within contiguous 32-byte directory entries, using as many as necessary (and sometimes actually spanning directory sectors) to represent filenames of up to 255 characters plus the null terminator. It flags these with an attribute-byte value of 0xf,

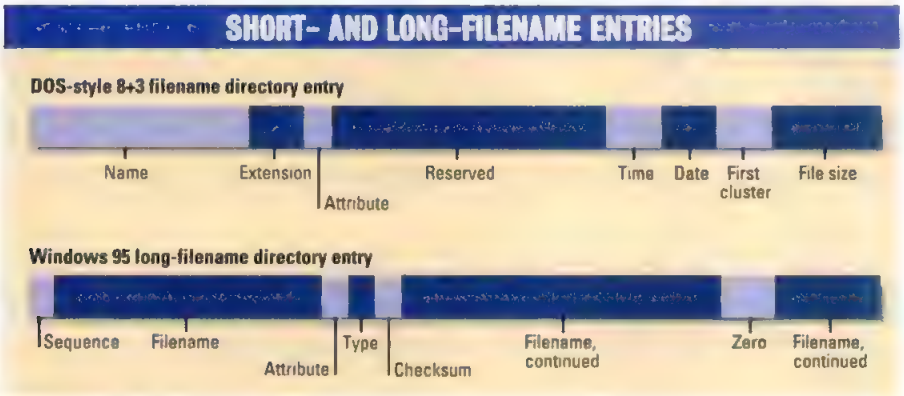

FIGURE 2: *The DOS and long-filename directory structures are able to coexist by virtue of the attribute byte, which is set to 0xf for long filenames—a value that's meaningless to DOS.*

which represents an impossible combination of read-only, hidden, system, and volume label. The DOS FAT file system ignores such items. This allows long filenames to live in harmony with the existing operating-system components.

There are three filename-storage areas comprising 26 bytes, but this space can accommodate only 13 characters. This is because long filenames are stored in Unicode format, which requires 2 bytes of storage per character. The checksum and sequence number fields are used by Windows 95 to verify the integrity of the long filename.

Long filenames differ from DOS-style filenames in other ways besides their length. They also differ in the characters they are allowed to contain. Long filenames can contain multiple periods, embedded spaces, and other characters—such as the plus sign, comma, semicolon, equal sign, and left and right square brackets—that were previously prohibited. (Actually, spaces in filenames were permitted in later versions of DOS, but most programs—including DOS utilities—didn't support this.) Also, case is preserved in long filenames, so that both uppercase and lowercase characters can be used.

We've seen how a long filename can coexist with the DOS directory structures, but that doesn't explain how DOS and Windows programs written prior to the advent of long filenames can access these files. As alluded to earlier, for each long filename, Windows 95 generates a DOS-style filename known as an *alias*. The directory entry for a long filename's alias immediately follows the entries for the long filename.

Windows 95 attempts to create the alias using the first six characters of the long filename followed by a numeric tail. The tail consists of the tilde character followed by a number that differentiates the alias from any others that share the same first six characters. If the long filename contains an extension, the first three characters of the extension are used as the extension for the alias. The first six characters of the alias do not match the long filename character-for-character if the long filename contains leading periods or embedded spaces, since these are skipped when Windows derives the first portion of the alias.

This summary only touches the surface. For more information on long-filename rules, see the book by Adrian King called *Inside Windows 95* (Microsoft Press, 1994) or the article on the Microsoft Developer's Network CD by Walter Oney called "Unconstrained Filenames on the PC! Introducing Chicago's Protected Mode FAT File System" (*Microsoft Systems Journal*, August 1994).

With this background information behind us, let's look further into the details of locating and retrieving long filenames.

LOCATING THE FAT

Since LFNDir will be going directly to the disk's FAT and directory areas, it must determine which sectors are inhabited by these DOS file system structures. This is readily accomplished by issuing the INT 21h `Get Device Parameters` function. This call returns a structure that describes the layout of the disk, including the number of FATs, number of sectors per FAT, and number of root-directory entries.

It's easy to find the location of the first root-directory sector. Just multiply the number of FATs by the sectors per FAT, and add the result to the location of the first FAT sector. The first FAT sector immediately follows the boot record, which is the first logical sector of the disk. Finding where subdirectories start isn't as straightforward, since these are not stored in a fixed location. I'll discuss this a little later.

Later in the search process, we'll need to read the contents of subdirectories from the disk. To do so, we'll have to translate the FAT entries for the starting and subsequent clusters into actual sector locations on-disk. Each FAT entry is an index into the disk's file area, the area of the disk that can be mapped by the FAT. So to prepare for this task, we calculate and save the sector number where the file area begins. This location immediately follows the root-directory sectors, and it is calculated by adding the number of root-directory sectors to the location of the first root-directory sector.

Armed with the location of the root-directory sectors, the number of FAT sectors, and the first sector of the file area, we're now prepared to start searching for the desired files.

SEARCHING DIRECTORIES

There are several LFNDir functions involved in the search process. At the highest level, `do_dir()` moves through each directory of the path and dispatches to the functions `find_in_root()` and `find_in_sub()`, which retrieve and search the appropriate directory sectors. The function `find_in_sub()` is available for downloading from PC Magazine Online.

In order to decide how many calls to make into these functions, `do_dir()` must determine how many directories are involved in the path portion of the file specification. It starts by counting the number of backslash characters in the file specification. This count will not necessarily equal the final number of levels to be searched. The number of levels is never known for certain until the last portion of the path is found. For example, if the file specification passed to LFNDir is C:\Level1*.*, there are two levels: the root directory and the Level1 directory. But if the file specification is C:\Level1\Foo and if Foo turns out to be a directory, there are three levels and the search is treated as "C:\Level1\Foo*.*". So when `do_dir()` is about to process the last path element, it calls `detect_subdir()` to determine if the last element is a subdirectory. If so, it tacks on the *.*, as shown in the example.

When locating the first directory of the path, `do_dir()` calls `find_in_root()` to search the root directory. To find all other levels within the path, `do_dir()` calls the `find_in_sub()` function. The `do_dir()` function passes these functions a pointer to the desired directory or filename, the attribute portion of the search criteria, and a pointer to a `find_context` structure that dictates where the search should start. The `find_context` structure stores the location of the last matching file or directory. The location information includes the directory sector, the entry offset within the sector, the last cluster, and the

sector offset within the cluster.

The `find_in_root()` function loops through each root-directory sector calling LFNDir's `find_match()` function, which performs all of the detailed matching logic. The `find_in_sub()` function also calls `find_match()`, but instead of simply looping through a fixed number of directory sectors, it must walk the FAT chain of clusters allocated for a given subdirectory. To accomplish this, it starts with the cluster number found in the directory entry for the subdirectory. It locates the first sector of the cluster and searches each sector within the cluster. After a cluster's worth of sectors has been inspected, it extracts from the FAT the next cluster in the chain. This continues until it detects the end of the allocation chain for the subdirectory.

The `find_match()` function called by `find_in_root()` must jump through quite a few hoops to find matching files and retrieve their long filenames. Let's take a look at these final steps leading to the long filenames we're seeking.

MATCHING THE FILES

The `find_match()` function searches all entries within a given directory sector. It may start at the beginning of the sector or, if it has found previous matches, resume searching within the sector. The function returns when a match is found or when the end of the specified directory sector is reached. During its processing, `find_match()` carries out a number of tasks. It matches the filenames, matches the attributes, retrieves the long filenames, and maintains a count of the number of directories or filenames it has encountered. Some of the logic required is surprisingly difficult.

First, `find_match()` must determine whether the path element it's searching for is a DOS-style filename. (This isn't totally straightforward, because names short enough to be DOS-style may contain characters such as embedded spaces that make them "long" filenames.) Next, picking up where it left off on the last match, `find_match()` must go through the directory entries in search of an alias (recall that long filenames precede their corresponding aliases). If the filename is DOS-style, it can compare the name to the alias; otherwise it must compare the name to the long filename.

In either case, prior to matching the filenames, `find_match()` must match the attribute byte in the directory entry for the alias with the search attribute. Users can override the default value of normal/read-only with the `/A` switch. If the values don't match, `find_match()` skips the entry and inspects the next one. After comparing the attribute byte, it compares the filenames.

> The find_match() function called by find_in_root() must jump through quite a few hoops to find matching files and long filenames.

When wildcards are used, the file specification must be checked against both the alias and the long filename, even if the file specification is short enough to be a DOS-style filename. For example, consider the long filename "this123456789," whose alias is "this12~1." The file specification "this123*" is short enough to be a DOS-style filename, but it will not match the alias. Therefore, if the file specification contains a wildcard and there's no match to the alias, the long filename must be checked as well.

The `find_match()` function then calls another LFNDir function, `retrieve_lfn()`, to acquire the long filename associated with an alias. The directory entries that hold a long filename always immediately precede the entry for the file's alias, so this function examines the entries just before the alias to pull out the long filename.

The set of entries that define a single long filename can actually span directory sectors, so if `retrieve_lfn()` reaches the beginning of the sector and the long filename still has not been fully extracted, it must search the previous directory sector as well, starting at the end. As it reads each directory sector, it saves the previous sectors' contents in holding areas (`prev_root_buf` for root-directory sectors and `prev_sub_buf` for subdirectory sectors). A pointer to the appropriate previous-sector buffer is stored in the `find_context` structure to facilitate long-filename retrieval.

If `find_match()` finds a match, it finishes up its work by adding to some counters. You may have noticed that the DIR command displays the total number of directories and files that were listed. To enable LFNDir to do this as well, `find_match()` looks at the attribute byte for the directory entry of the alias and, depending on its value, adds to the `find_context` structure's `number_dirs` or `number_files` elements before returning. The search functions then return to `do_dir()`, which wraps up all this activity by finally yielding what we've been seeking from the start: a display of the desired DOS-style filename and its long-filename counterpart.

With operating-system features, as well as with life in general, it's difficult to go backwards once you've grown accustomed to a new level of fulfillment. This is certainly the case with long filenames; it's painful when they disappear. The next time you must restart your system in DOS mode or find yourself working on a DOS platform with a disk volume that's been written under Windows 95, don't suffer with those DOS-style aliases. Launch LFNDir and unveil those wonderful long filenames. PC

Rick Knoblaugh is a systems-programming expert and a frequent contributor to PC Magazine. *Sheryl Canter is the editor of the Utilities column and a contributing editor of* PC Magazine.

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User-to-User

BY NEIL J. RUBENKING

Managing Windows Start-Up

Sometimes programs run automatically at Windows start-up that I would rather not run. When there's an entry in your StartUp folder, solving this problem is a snap: You simply delete the offending shortcut from the Start-Up folder.

But often there isn't a shortcut in the StartUp folder. In that case, run Regedit and navigate to `HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\Run`.

If you see an entry for the program, delete the entry and the program will no longer start automatically. You can also check `HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\RunServices` *for unwanted entries.*

You may also want to take a look at Win.ini. Run Sysedit and switch to the Win.ini window. At the top, in the `[windows]` *section, look for the string* `load=`. *If you find any references to programs you'd rather not run automatically, delete them and your worries are over.*

JONATHAN MANEY
via the Internet

PC MAGAZINE: This topic comes up frequently in relation to other questions, but it's important enough to merit its own article. Note that Win.ini can have two lines that launch programs at start-up, the `load=` entry mentioned above and another called `run=`. If a program appears in either line, it will be launched at start-up.

There's always a possibility that a seemingly annoying program may actually be performing some beneficial task you hadn't realized. Rather than deleting the reference that causes the program to run at start-up, the cautious user will disable it. In the case of StartUp folder items, it's sufficient to move the link to a different folder in the Start menu tree. On my own system, I maintain a folder called StartNOT! for this purpose.

To disable the loading of a program from the `Run` or `RunServices` keys in the registry, first locate the program's line in the right-hand pane of Regedit. Double-click on that line, and insert *REM* (for *remark*) at the beginning of the line.

The `load=` and `run=` lines in Win.ini can contain multiple start-up commands, separated by semicolons. If there's just one command on the line, insert a semicolon at the start of the line; this will cause Windows to treat the line as a comment. If the line contains multiple commands, start by making an identical copy of it just below the original. Prefix the copy with a semicolon, and then edit the original to remove the offending command.

Once you've run your machine for a number of days with no trouble, you can decide to permanently eliminate the start-up programs that you temporarily disabled. Go back and delete the shortcuts you moved out of the StartUp folder, and then delete the registry values or the Win.ini lines you commented out.

Enabling Mouse Interaction In Batch Files

The death of the batch file has been greatly exaggerated! Running a batch file is still the only way to perform a series of actions without the help of either third-party software or a macro-running behemoth like Word or Excel. I often run batch files by double-clicking on an icon on my desktop or in the Explorer. I even drop files onto a batch file to pass filenames as parameters.

There is one drawback, though: the lack of mouse interaction with the batch file. Any Pause *or* Choice *command forces you to reach for the keyboard. To remedy this, I wrote a little program called Paws.com (think "mouse pause"). Paws.com lets you put a* "Press any key . . ." *pause in a batch file but—unlike the* Pause *command—lets you resume by clicking with the mouse. You can use the* If Errorlevel . . . *command to learn which mouse button was clicked.*

You can feed the script Paws.dbg (Figure 1)

```
a 100
;———— Paws.Dbg Debug script
mov ax,0c06     ;clear kbd buffer
mov dl,ff
int 21
mov ax,0006
mov bx,0
int 33   ; clear pending left btn clicks
mov ax,0006
mov bx,1
int 33   ; clear pending right btn clicks
;
;———— againKey
mov ah,0b       ;in-key status...
int 21          ;...and Ctrl-Break check
or [147],al     ;al=FF if any key; 00 if none
;
;———— chkmous
mov ax,0006
mov bx,0        ;left btn released lately?
int 33
or byte [147],bl
mov ax,0006
mov bx,1        ;right btn released lately?
int 33
shl bl,1
or byte [147],bl
;
cmp byte [147],0
je  117         ;no, loop to againKey
;
;———— exit, setting errorlevel
mov al, [147]
mov ah,4c
int 21
; ———— errorlevel variable storage
db 00

rcx
48
n paws.com
w
q
```

FIGURE 1: *Feed this script into Debug to generate Paws.com, a mouse click–aware Pause command for batch files.*

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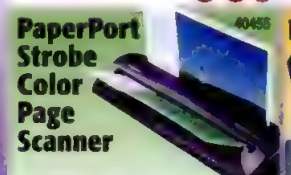

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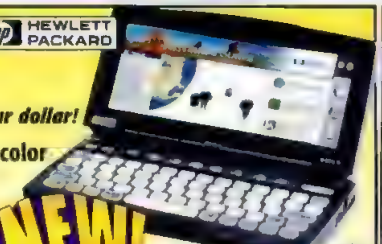

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```
@echo off
rem You could do some work here such as copying files, etc.
rem Then pause the batch, e.g., to check for errors.
echo.
echo Press any key or click with the mouse...
paws
rem (it will be errorlevel 0 on on resume after Ctrl+Break)
if not errorlevel 1 goto continue
if errorlevel 1 if not errorlevel 2 echo Primary Btn clicked!
if errorlevel 2 if not errorlevel 3 echo Secondary Btn clicked!
if errorlevel 3 if not errorlevel 4 echo BOTH Btns clicked!
if errorlevel 4 echo A key was pressed!
:continue
```

FIGURE 2: *This batch file shows how Paws.com can pause a batch file and identify the mouse button that was used to end the pause.*

into Debug to produce Paws.com. Note that there's no need for redirected I/O. Just type the text into, say, Notepad, then select it all and copy it to the clipboard. Open a DOS *box and run Debug. Then click on the* Paste *button at the top of the window (or press Alt-<Spacebar>-E-P).*

Paws first clears the keyboard buffer and discards any mouse clicks that may have been queued up before the program was executed. Then it waits in a loop until a key is pressed or a mouse button is clicked. Note that the program is written so that Ctrl-Break and Ctrl-C will work as expected—and let you terminate or resume the batch file.

The sample batch file, PawsTest.bat (Figure 2), shows how to use Errorlevel *to make program-flow decisions based on the mouse button that was clicked.*

DAN MERIT
via the Internet

PC MAGAZINE: Batch-file enthusiasts tend to collect tiny, specialized programs that widen the scope of what a batch file can accomplish. Paws should become part of any such collection—it's a keeper!

One point worth noting is that the "left mouse button" need not be on the left side of the mouse. The Mouse applet in Control Panel lets you swap the buttons, for left-handed mousing. When you do so, the primary ("left") mouse button, the one that you use to activate applications, press buttons, and so on, is physically on the right side of the mouse. The secondary ("right") mouse button, the one that brings up context menus, is physically on the *left* side of the mouse. Because Paws correctly tracks this change, I modified the PawsTest.bat demo to refer to primary and secondary buttons, rather than right and left buttons.

This reader recommends running Debug in a DOS window and pasting the Paws.dbg script into it. Chances are good that this procedure will work fine. I always prefer to use DOS-based redirection when processing Debug scripts, however. In that case, you would issue the command `DEBUG < PAWS.DBG > PAWS.LOG` and then check the log file for any instances of the string `^ Error`. If any errors turn up, you can correct the script and try again. As always, the blank lines before the line `rcx` and after the final `q` are essential for proper operation of the script.

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HARDWARE

Confusion over SCSI Standards

SCSI apparently is still not dead, despite advances with EIDE devices. Could you give a little insight into the various types of SCSI—Wide, Ultra, 2, Fast, and so on? Must there be a specific type of SCSI card for each type of SCSI device? Or will the most expensive (and latest) type handle all SCSI devices?

JACK STAUFFER
Lewisburg, Tennessee

PC MAGAZINE: You're right on target that SCSI (small computer system interface) still offers some advantages over other interfaces, and you're certainly not alone in your confusion over the different varieties of the interface. The Tutor column in our issue of March 10, 1998, took an in-depth look at the various flavors of SCSI.

One of the biggest advantages of SCSI is that it is designed to handle multiple devices of different functions. IDE is designed for data storage only, so you won't find any IDE scanners. Some nonprinting peripherals make use of parallel ports, but these ports are not as fast as SCSI and can have configuration problems when you try to share one with a printer. In its early days, SCSI had a well-deserved reputation for being difficult and fussy to configure, but in recent years it has become a reliable and stable interface.

SCSI is based on a design by Shugart Associates. Unlike some other interfaces that act simply as communication ports for the computer's processor, SCSI uses an independent bus that's almost like a local area network operating within your computer. The host adapter provides the communications link to the CPU, and up to 7 devices can be installed along the bus. (Newer controllers can handle as many as 15 devices.) Each device has its own controller, which handles the communications between device and bus, much as a workstation on a network makes its hard disk available to other stations on the network.

The extra controller circuitry is what makes SCSI devices more expensive than some other interfaces, especially compared with IDE drives. This additional on-board intelligence also makes SCSI easier and more flexible to configure.

The original SCSI standard was approved by the American National Standards Institute (ANSI) in 1986 and was followed by SCSI-2 in 1994. A SCSI-3 standard is under development. The three standards differ primarily in their maximum data transfer rates. SCSI-2 is twice as fast as the original and is often called *Fast SCSI*. SCSI-3 has a mode that's twice as fast as Fast SCSI and is called either *Fast-20* or *Ultra SCSI*. The SCSI buses also vary in how much data they can pass at a time. The original standard was 8 bits, and there is also a 16-bit version—called *Wide-SCSI*—that doubles data throughput.

As a result, there are six different data-transfer speeds for SCSI devices:

	Standard SCSI	Fast SCSI	Ultra SCSI
8-bit	5 MBps	10 MBps	20 MBps
16-bit	10 MBps	20 MBps	40 MBps

A faster interface has started shipping recently. *Ultra2* doubles Ultra SCSI speeds, resulting in a maximum transfer rate of 40 MBps for the 8-bit bus and 80 MBps for the 16-bit bus.

In general, the newer versions are backward-compatible. That means you can attach a standard SCSI device to a Fast SCSI bus and expect it to work, though only at the standard SCSI rates. But you can't mix standard and Wide devices on the same bus, because they use different bus widths. Most Wide controllers, however, have standard 8-bit connectors as well.

So there is good reason to be confused. The simple answer, however, is to buy an Ultra SCSI host adapter, which should cost considerably less than a Wide or Ultra2 adapter. Unless you need the extra performance of Ultra2 or have a Wide SCSI device you want to use, the Ultra adapter will give you most of the performance from any 8-bit SCSI device at a good price.—*Alfred Poor*

OPERATING ENVIRONMENTS

Changing the Windows Installation Drive

Recently, a friend asked me if there is a way to change the drive/directory from which Windows 95 was installed. It seems that Windows 95 expects to find the system files where it was originally installed and, unlike Windows 3.11, does not let the user select an alternative. Is there a way to change the Windows 95 installation drive/directory?

THORNTON ROSE
Pensacola, Florida

PC MAGAZINE: Run Regedit from the Start menu's *Run* command. In the resulting tree-like display, navigate to `HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\Setup`. In the right-hand pane, locate the value named `SourcePath`; it will almost certainly contain a reference to your old CD-ROM location, for example F:\Win95\. Double-click the name `SourcePath` and change the drive letter in the data so it points to your current CD-ROM location. Press *OK*, close Regedit, and check to be sure you can now access Windows 95 setup.

This should work fine if you're installing from the same storage area at a different drive letter. If you change media—perhaps by copying the Windows 95 setup files to your hard disk—you may have trouble, as Windows 95 also tracks the media type of the setup source. The data for the `SourcePathType` value is set to 05 00 00 00 for a CD-ROM drive; I haven't found the values for other media types documented.—*Neil J. Rubenking*

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WORD PROCESSING

Getting Back Control of Pictures in Word 97

In Versions 6 and 7 of Microsoft Word, I was able to use AutoCorrect to insert my signature into a document. To set up the AutoCorrect feature, I started by scanning a bitmap of my signature and inserting it into a document, with the Insert | Picture *command. I'd then adjust the size, if necessary, by clicking on the graphic object to select it, then clicking on a corner of the object and holding the mouse button down while dragging the signature to the right size.*

With the signature still selected, I would choose Tools | AutoCorrect. *The AutoCorrect dialog box would open, with a portion of the bitmap showing in the* With *box, as the item to replace an abbreviation with. I would enter my initials into the* Replace *box, as the item to replace, and choose* Add *and then* OK *to close the dialog box. From then on, any time I wanted to enter my signature, I only had to enter my initials followed by the Spacebar or Enter key and AutoCorrect would insert my signature.*

This does not seem to work in Word 97, and I badly miss the capability. Is there a way to get this feature or its equivalent back?

BOB WILLITS
via the Internet

PC MAGAZINE: The technique you describe works just as well in Word 97 as in Word 6 and 7. However, it doesn't work with the default settings for inserted pictures. By default, Word 97 inserts pictures with an option called Float Over Text. This is a new name for the equivalent of *frames* in Word 6 and 7.

In the earlier versions of Word, inserted pictures were by default inserted as in-line objects. They had a specific position in the text line and would move back and forth, just like a text character, as you added or deleted the text in front of the picture. If you wanted to move the picture to any arbitrary spot on the page, you had to select it and choose *Insert | Frame*. Once it was inserted in a frame, you could drag the frame—and the picture inside the frame—to any place on the page.

In Word 97, the default for inserting a picture is to put it in the equivalent of a frame—or have it *float over text*, to use the new jargon. (Note, however, that there are some differences in behavior between frames in Word 6 or 7 and the float-over-text feature in Word 97, which is why I call it the equivalent of a frame.)

For unsophisticated users, this is probably a less confusing way to deal with pictures, since they can simply insert a picture and then drag it wherever they want to on the page without having to know about frames. But it's often confusing for old hands at Word, who expect the pictures to be inserted as in-line objects and to behave differently from those that are set to float over text.

The problem in this particular case is that you can't use a picture defined to float over text as an AutoCorrect replacement item (for lack of a better term). However, you can redefine the picture to turn off the float-over-text feature or simply import it without that setting. And once you've turned the feature off, you can use the picture as an AutoCorrect item.

> In Word 97, how can I insert my signature image with AutoCorrect the way I could in Word 6?

To check the current state of a picture, and turn the float-over-text feature on or off, right-click on the picture and choose *Format Picture*, then *Position*. Make sure there is no check in the *Float Over Text* check box. Then choose *OK* to close the dialog box. The procedure Mr. Willits described will now work. To import a picture as an in-line object, choose *Insert | Picture | From File*, select the picture to import, and make sure the *Float Over Text* check box on the right side of the dialog box is not checked before choosing *Insert*. Alas, there is no option to turn off *Float Over Text* as the default setting. If your pictures are behaving in strange ways, a good place to start troubleshooting is checking this setting.—*M. David Stone*

SPREADSHEETS

Removing Unused Rows From Forms

I use Excel 97 to create purchase orders in template form for my customers. When I receive an order from a customer, I enter the quantity the customer wants for each item into the spreadsheet in the column that specifies quantity, and the spreadsheet does the rest. However, because the customer does not order every item I offer each time, I must hold the Ctrl key down, select each row in which there was nothing ordered, and then select Delete *from the Edit menu. I would like to have a macro start at the top of the column and, when it finds an empty cell (where nothing was ordered), delete that line; it would continue down to the bottom, so only the items that were ordered would remain.*

RICK LITT
via the Internet

PC MAGAZINE: The following macro works just great in Excel 5 and Excel 95:

```
Sub DeleteEmptyRows()
  For Each c In Range("Ordered")
    If IsEmpty(c.Value) Then
      c.EntireRow.Delete
    End If
  Next c
End Sub
```

Applied to exactly the same data in Excel 97, however, this code occasionally misses rows that it should delete. When I tried the macro, I often had to run it twice to get all the appropriate rows deleted. With a larger data set, I would guess I might have had to run it more than twice. I therefore concocted the following, slightly more elaborate version to cope with what I assume is an Excel 97 bug:

```
Sub DeleteEmptyRows()
  Do
    counter = 0
    For Each c In Range("Ordered")
      If IsEmpty(c.Value) Then
        c.EntireRow.Delete
        counter = counter + 1
      End If
    Next c
  Loop Until counter = 0
End Sub
```

Both versions assume that order quantities have been entered into a range named `Ordered`. Obviously, you could use a different range name in the `For Each` line or simply specify a range address such as `Range("G2:G30")`.

Since row deletion via macro is an irreversible act, I would suggest hiding instead. The following macro gets rid of the empty lines by hiding them:

```
Sub HideEmptyRows()
  For Each c In Range("Ordered")
    If IsEmpty(c.Value) Then
      c.EntireRow.Hidden = True
    End If
  Next c
End Sub
```

This hiding macro—unlike its deleting counterpart—seems to work fine in Excel 97, without the counter and `Do` loop.
—*Craig Stinson*

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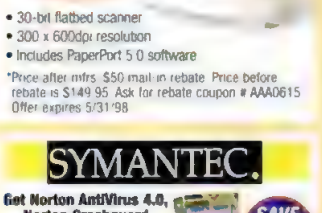

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- 2GB hard drive
- 20X CD-ROM
- 12.1" SVGA Display

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#99913	TP380ED	166MHz MMX®	16	2.1GB	20X	12.1" DSTN	$1,799
#28626	TP380X	233MHz MMX®	32	3.2GB	20X	12.1" HPA	$2,379
#99915	TP380ED	166MHz MMX®	16	3.0GB	20X	12.1" TFT	$2,659
#28627	TP380XD	233MHz MMX®	32	4.0GB	20X	12.1" TFT	$3,149
#28625	TP380XD	266MHz MMX®	32	5.1GB	20X	12.1" TFT	$3,619
ThinkPad 560							
#28622	TP560X	200MHz MMX®	32	2.1GB	—	12.1" HPA	$2,379
#96041	TP560	166MHz MMX®	16	2.1GB	—	12.1" TFT	$2,849
#11247	TP560X	233MHz MMX®	32	4GB	—	12.1" TFT	$3,429
ThinkPad 770							
#99904	TP770	200MHz MMX®	32	3.2GB	—	13.3" TFT	$3,599
#99908	TP770	233MHz MMX®	32	4.0GB	—	13.3" TFT	$4,199
#99910	TP770	233MHz MMX®	32	5.1GB	—	14.1" TFT	$4,949

*Pentium® processor with MMX™ technology.

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#11515	Pro 7580	233MMX®	32	3.2	20X	13.3" TFT	56k	$3,299
#28362	Pro 7590	266MMX®	48	4.0	20X	13.3" TFT	56k	$4,199

*Pentium® processor with MMX™ technology

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#94064	1550DM	133MHz	16	1.4GB	10X	12.1" TFT	$1,699
#14708	1540DM	150MHz MMX®	16	2.1GB	20X	12.1" CSTN	$1,899
#26785	1560DM	166MHz MMX®	16	3.1GB	20X	12.1" CSTN	$1,949
#14710	1590DMT	166MHz MMX®	16	2.1GB	20X	12.1" TFT	$2,649
#26786	1592DMT	233MHz MMX®	32	3.1GB	20X	12.1" TFT	$3,249
Armada 4100/4200 Series							
#26783	4210T	233MHz MMX®	32	3.0GB	—	12.1" TFT	$3,399
#26784	4220T	266MHz MMX®	32	4.0GB	—	12.1" TFT	$3,899
NEW Armada 7300 Series							
#99538	7350MT	166MHz MMX®	32	2.1GB	—	12.1" TFT	$2,949
#24711	7360DMT	200MHz MMX®	32	3.0GB	20X	12.1" TFT	$3,449
#24712	7370DMT	233MHz MMX®	32	4.0GB	20X	12.1" TFT	$4,599
#26787	7380DMT	266MHz MMX®	32	4.0GB	20X	12.1" TFT	$4,599
#26788	7380DMT	266MHz MMX®	32	4.0GB	20X	12.1" TFT	$4,699
Armada 7700 Series							
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#94062	7730MT	166MHz MMX®	32	2.1GB	—	12.1" TFT	$3,349
#94046	7750MT	166MHz MMX®	32	2.1GB	—	12.1" TFT	$3,549
#24713	7790DMT	233MHz MMX®	32	5.0GB	20X	13.3" TFT	$4,799
#23932	7770DMT	233MHz MMX®	32	3.0GB	20X	12.1" TFT	$3,899
#26790	7792DMT	266MHz MMX®	32	5GB	20X	13.3" TFT	$5,199
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*Pentium® processor with MMX™ technology.

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#97423	166MHz MMX®	16	3.2GB	—	DT	$849
#97426	200MHz MMX®	32	3.2GB	—	DT	$999
#97427	200MHz MMX®	32	3.2GB	16X	MT	$1,149
#97428	233MHz MMX®	32	3.2GB	16X	DT	$1,199
#14643	PII 233MHz MMX®	32	3.2GB	16X	DT	$1,499
#14641	PII 266MHz MMX®	32	3.2GB	16X	DT	$1,699
#14637	PII 300MHz MMX®	32	3.2GB	16X	MT	$1,999
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Network Ready PCs for Enterprise Environments						
#97430	166MHz MMX®	32	3.2GB	—	DT	$1,099
#97442	200MHz MMX®	32	2.4GB	—	DT	$1,149
#97421	233MHz MMX®	32	3.2GB	16X	MT	$1,349

Deskpro 4000 Series (Continued)

#14633	PII 233MHz	32	3.2GB	16X	MT	$1,649
#14635	PII 266MHz	32	3.2GB	16X	MT	$1,849
#14625	PII 300MHz	32	3.2GB	16X	DT	$2,099
#27833	PII 333MHz	32	3.2GB	16X	DT	$2,349

Presario Desktops

Order#	Model	Pentium® processor	RAM	HD	CD	Modem	Price
#27283	2240	200MHz AMD K6 MMX®	32	2.1GB	20X	56.6	$749
#25867	4540	233MHz AMD K6 MMX®	32	3.2GB	20X	56K	$949
#25868	4550	233MHz AMD-K6 MMX®	32	4.0GB	24X	56K	$1,099
#25869	4640	PII 266MHz MMX®	32	4GB	DVD	56K	$1,499
#25871	4860	PII 300MHz MMX®	64	8GB	DVD	56K	$1,799
#25872	4860	PII 333MHz MMX®	64	8GB	DVD	56K	$2,299

*Pentium® processor with MMX™ technology.

HP Vectra Series Desktops

- 200 - 233MHz Pentium processor with MMX™ technology
- 16 - 32MB RAM expandable to 128MB
- 2.1 - 3.2GB hard drive
- 24X CD-ROM (Selected models)

Monitor sold separately

as low as $1,059! #27301

HP Vectra VE4

Order#	Model	Pentium® processor	RAM	HD	CD	NIC	Price
#27301	D5605A	200 MMX®	32	3.2GB	—	—	$1,059
#27304	D5612A	233 MMX®	16	2.1GB	—	—	$1,059
#27314	D5616N	233 MMX®	32	3.2GB	—	—	$1,239
#27306	D5613A	233 MMX®	16	2.1GB	—	10/100	$1,129
#27311	D5614A	233 MMX®	32	2.1GB	24X	—	$1,299

HP Brio Business Series

Order#	Model	Pentium® processor*	RAM	HD	CD	Modem	Price
Business Models							
#99511	8012	166MHz MMX®	16MB	2.1GB	—	—	$849
#99512	8014	200MHz MMX®	16MB	2.1GB	—	—	$869
#99513	8017	233MHz MMX®	32MB	3.2GB	—	—	$1,079
Advanced Business Models							
#99514	8032	166MHz MMX®	16MB	2.1GB	16X	—	$1,019
#99515	8034	200MHz MMX®	32MB	2.1GB	16X	—	$1,189
#99483	8037	233MHz MMX®	32MB	3.2GB	24X	—	$1,299
Advanced Business Communications Models							
#99484	8172	166MHz MMX®	16MB	2.1GB	16X	56Kbps	$1,219
#99485	8174	200MHz MMX®	32MB	2.1GB	24X	56Kbps	$1,299
#99486	8175†	200MHz MMX®	32MB	2.1GB	24X	56Kbps	$1,389
#99487	8177	233MHz MMX®	32MB	4.0GB	24X	56kbps	$1,449

*Intel Pentium® processor with MMX™ technology †Includes an HP CMS T3000 tape backup drive

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#99888	656234U	200MHz MMX®	32	2.5GB	—	$1,299
#99885	656236U	200MHz MMX®	32	4.2GB	—	$1,259
#99884	656238U	200MHz MMX®	32	4.2GB	24X	$1,379

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- 2.5 to 4.2GB EIDE HD
- 256K L2 Cache
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#96201	628269U	166MMX®	16MB	2.5GB	—	$849
#14853	628275U	200MMX	32MB	2.5GB	—	$1,039
#96203	628266U	200MMX®	32MB	2.5GB	16X	$1,169
#15126	628278U	200MMX	32MB	2.5GB	16X	$1,239
#15124	628286U	233MMX	32MB	2.5GB	—	$1,169
#27406	656113U	PII233	32MB	2.5GB	—	$1,249
#27407	656132U	PII266	32MB	2.5GB	—	$1,439
#27408	656134U	PII266	32MB	4.2GB	—	$1,499
#27409	656135U	PII266	32MB	4.2GB	—	$1,549

*Pentium® Processor with MMX™ technology | MiniTower Systems

SONY Sony PCV 220 with Pentium® II Processor!

Order#	Model	Pentium® processor	RAM	HD	CD	Modem	Price
#28114	PCV-210	266 MMX® PII	32	4.3GB	24X	56K	$1,699
#28115	PCV-230	300 MMX® PII	32	3.2GB	24X	56K	$1,999

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#91234	HP DeskJet 694C 600dpi, 6ppm black, 3.5ppm color FREE Photo Kit	$239.00
#74696	HP DeskJet 340 Portable Printer up to 3ppm FREE Color Kit	$269.00
#14434	HP DeskJet 722C PhotoRet II 8ppm black, 4ppm color	$299.00
#14435	HP DeskJet 890Cse PhotoRet II 9ppm black, 5ppm color	$399.00
#28381	HP DeskJet 1120Cse Printer prints 4" x 6", up to 13" x 19" NEW!	$499.00
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6ppm

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#22658	HP LaserJet 4000N 8MB RAM/HP JetDirect Print Server	$1499.00
#28432	HP LaserJet 5000 11" x 17", 16ppm, 4MB NEW!	$1499.00
#77088	HP LaserJet 5Si 600dpi, 24ppm printing, 40MHz, 4MB	$2448.00
#79342	HP Color LaserJet 5 Printer 1200dpi, 10ppm black 3ppm color	$3959.00

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#96777	Optra E+ 600dpi, 6ppm, 2MB	$378.00
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SONY

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- .25mm dot pitch

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#24681	CPD 200ES	17/16"	1280 x 1024	0.25mm	$599.00
#24867	CPD-200GS	17/16"	1280 x 1024	0.25mm	$659.00
#24869	CPD 400PS	19/18"	1600x 1200	0.25mm	$1,099.00
#24870	GDM 500PS	21/20"	1600 x 1200	0.25mm	$1,699.00

ViewSonic®

#36126	E655	15"/13.8"	1280 x 1024	0.28mm	$299.00
#37587	G771	17"/16"	1280 x 1024	0.27mm	$474.00
#39864	G773	17"/16"	1280 x 1024	0.26mm	$499.00
#24073	G790	19"/18.0"	1600 x 1280	0.26mm	$899.00
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UMAX

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- 300 x 600 optical resolution
- 4800dpi maximum
- 8.5" x 11.7" scanning area

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#94312	Umax 1200S 30-bit, 600x800dpi, 9600 max dpi (SCSI)	$249.00

HEWLETT PACKARD

#94714	HP ScanJet 5s Sheet-fed Scanner (after $70 mail-in rebate)	$129.00
#25471	HP ScanJet 5100Cse Scanner 36-bit Color Image Processor	$299.00
#98529	HP ScanJet 6100Cse Scanner 45-bit Color Image Processor	$799.00

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```
Public Function ConfirmActionQueries(bOption As Boolean) As Variant
'*****************************************************************
' ConfirmActionQueries(bOption As Boolean) As Variant
'
' If bOption is False, turns off the "Confirm Action Queries"
' option in the Edit/Find tab under Tools, Options. Otherwise,
' the option is turned on. Returns the prior option setting.
'*****************************************************************
On Error GoTo Err_ConfirmActionQueries
ConfirmActionQueries = Application.GetOption("Confirm Action Queries")
If bOption = False Then
 Application.SetOption "Confirm Action Queries", False
Else
 Application.SetOption "Confirm Action Queries", True
End If

Exit_ConfirmActionQueries:
 Exit Function

Err_ConfirmActionQueries:
 MsgBox Err.Description
 Resume Exit_ConfirmActionQueries

End Function
```

FIGURE 1: *The ConfirmActionQueries function can be used programmatically to turn on or off the* Confirm Action Queries *setting in Access's Tools | Options | Edit/Find dialog.*

DATABASES

Sending a Query to a Table in Access

I need to turn the output from a Microsoft Access query into a table and then add fields to the table. The only way I've been able to accomplish this has been by first exporting the query to a dBASE file and then importing it back to Access. Is there a better way to do this?

JOEL KUNIN
San Diego, California

PC MAGAZINE: Change your query from a select query to a make-table query. You can then create a macro to run the make-table query followed by the SQL `ALTER TABLE` command, to add fields to the table.

To create the make-table query, highlight your existing query in the database window, then select the Edit menu and choose *Copy*. Next, select the Edit menu again and choose *Paste*. Enter the name of the new make-table query in the Paste As dialog. If your existing query is named "Top Ten," you might name the new query "Make Table: Top Ten."

Next, highlight the new query and choose *Design*. Then select the Query menu and choose *Make Table*. In the Make Table dialog, enter the name you want to assign to the table created by this query. You might name the table "Top Ten Table," for example. At this point you can give the make-table query a test run.

To create the macro, select the *Macros* tab in the database window and choose *New*. Choose the *OpenQuery* action. Then, in the *Action Arguments* section, select the *Query Name* text box and choose the make-table query that we just created. That completes the first line of the macro.

On the second line choose the *RunSQL* action. Then, in the *Action Arguments* section, select the *SQL Statement* text box and enter the following, substituting your new table name for *[Top Ten Table]*, your new column name for *MyCol*, and the appropriate data type and length for *Text(20)*:

```
ALTER TABLE [Top Ten Table] ADD COLUMN
MyCol Text(20);
```

If you need to add additional columns to the table, add more RunSQL lines to the macro.

To save the macro, select the File menu, choose *Save*, and enter a name for the macro—perhaps "Make TopTen Table," for example. To give it a try, select the Run menu and choose *Start*.

That's it. Now whenever you need to create the table, you can run the macro. When you do, Access may present a number of confirmation dialogs if you have *Confirm Action Queries* checked in your Tools | Options | Edit/Find dialog. You can get rid of most of them by programmatically setting this option. To do that you'll need the `ConfirmActionQueries` function shown in Figure 1.

The `ConfirmActionQueries` function accepts a single True/False argument and uses the `SetOption` method of the `Application` object to set the *Confirm Action Queries* setting. To add the function to your database, select the *Modules* tab and open an existing module or add a new one. Then select the Insert menu, choose *Procedure*, enter *ConfirmActionQueries* for the name, and choose *OK*. Then type in the function as it appears in Figure 1.

We'll insert two calls to this function in our Make TopTen Table macro—one before the existing actions to turn off the confirmation and one after the existing actions to turn the confirmations back on. To do this, select the *Macros* tab and open the macro. Then place the insertion point in the first row, select the Insert menu, and choose *Row*. In the empty row that results, choose the *RunCode* action. Then type the following in the *Function Name* text box in the *Action Arguments* section: *ConfirmActionQueries(False)*.

Now place the insertion point in the first empty row following the existing macro actions. Choose the *RunCode* action and then type the following in the *Function Name* text box in the *Action Arguments* section: *ConfirmActionQueries(True)*.

That accomplishes turning off the confirmations at the beginning and turning them on again at the end. Don't forget to save your macro at this point. Now you can run the macro whenever you need to.—*Sal Ricciardi*

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8 x 32 32 mg EDO	79	79	79	512 x 32	8	–	
4 x 32 16 mg EDO	39	39	39	256 x 32	5	–	
2 x 32 8 mg EDO	21	21	21	16 x 36 64 mg	189	189	189
1 x 32 4 mg EDO	15	15	15	8 x 36 32 mg	89	89	89
16 x 32 64 mg	199	199	199	4 x 36 16 mg	49	49	49
8 x 32 32 mg	89	89	89	2 x 36 8 mg	34	34	34
4 x 32 16 mg	34	34	34	1 x 36 4 mg	18	18	18
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ATI Xclaim 3D	4Meg SGRAM	59
ATI 3D Xpression	2Meg SGRAM	49
Apple Power Mac 4400		49
NEC Powermate Pro 150, 220	2Meg/4Meg WRAM	129/199
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Compaq Presario Video 2138/2-001	1Meg	29
Compaq Deskpro 2000, 4000, 6000	2Meg/8Meg WRAM	129/199
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G5-166M, 200M Millenia System – SDRAM	8Meg/16Meg/32Meg/64Meg	39/49/69/159
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Netserver LH Plus 5/133 5/166 (EDO, ECC)	16Meg/32Meg/64Meg/128Meg	69/89/209/439
Netserver 4/33LM – 5/100LM (pairs)	4Meg/8Meg/16Meg/32Meg	14/23/49/89
Netserver 5/75LS – 5/133 LS4 (pairs)	4Meg/8Meg/16Meg/32Meg	14/23/49/89
Pavilion 5010-7170 (pairs)	4Meg/8Meg/16Meg/32Meg	14/23/49/89
Vectra 500 (EDO pairs)	4Meg/8Meg/16Meg/32Meg	14/23/49/89
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Aptiva M Series	4Meg/8Meg/16Meg/32Meg	12/20/42/79
PC 330 Models 6571-6576	4Meg/8Meg/16Meg/32Meg	12/20/42/79
PC 330 Model 6577 (EDO pairs)	4Meg/8Meg/16Meg/32Meg	12/20/42/79
PC 350 Models 6587-6589	4Meg/8Meg/16Meg/32Meg	12/20/42/79
PC 350 Model 6588 (pairs)	4Meg/8Meg/16Meg/32Meg	12/20/42/79
PC 350 Model 6589 (EDO pairs)	4Meg/8Meg/16Meg/32Meg	12/20/42/79
PC 350 Models 6873-6879 (pairs)	4Meg/8Meg/16Meg/32Meg	12/20/42/79
PC 350 Model 6879 (EDO pairs)	4Meg/8Meg/16Meg/32Meg	12/20/42/79
PC 350 Models 6885-6889 (pairs)	4Meg/8Meg/16Meg/32Meg	12/20/42/79
PC 750 Model 688 (EDO pairs)	4Meg/8Meg/16Meg/32Meg	12/20/42/79
PC Server 310 (pairs)	4Meg/8Meg/16Meg/32Meg	12/20/42/79
PC Server 520 (EDO pairs)	4Meg/8Meg/16Meg/32Meg	59/79/149/249
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Thinkpad 365X 365XCD 8Meg/16Meg/32Meg		39/59/149		199	
Thinkpad 380 380D 380ED 4Meg/8Meg/16Meg/32Meg		49/59/89/179		119	229
Thinkpad 500 500CS 4Meg/8Meg		49/69/99	180	229	
Thinkpad 560 560E 8Meg/16Meg/32Meg/64Meg		49/69/149/339		349	
Thinkpad 700 700_750 750_CL/755X 8Meg/16Meg/32Meg/64Meg		39/79/159/249	140/175	179	
Thinkpad 701 701C 701CS 4Meg/8Meg/16Meg/32Meg		79/29/79/159		119	
Thinkpad 755C CE CD, CS 8Meg/16Meg/32Meg		49/69/129/249	140	179	271
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Thinkpad 760E ED, EL, XD 8Meg/16Meg/32Meg		49/69/149	140	179	271
Thinkpad 760XD, 760XL 8Meg/16Meg/32Meg/64Meg		49/69/159/249	140	179	271
Thinkpad 770 770D 770X 8Meg/16Meg/32Meg/64Meg		49/69/159/249	140	179	271
Thinkpad 770 (SDRAM) 8Meg/16Meg/32Meg/64Meg		79/109/189/299			

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Deskpro 575 5120 5133 5150 5180 (EDO pairs)	4Meg/8Meg/16Meg/32Meg	17/29/49/79
Deskpro 2000 4000 6000 Series (EDO pairs)	4Meg/8Meg/16Meg/32Meg	17/29/49/79
Deskpro 2000 4000 6000 Series	16Meg/32Meg/64Meg/128Meg	45/59/149/405
Deskpro 6200	16Meg/32Meg/64Meg/128Meg	61/99/225/489
Deskpro 5/90M 5/66M 4DS60 (quads)	4Meg/8Meg/16Meg/32Meg	16/39/54/89
Deskpro XL 6150 6200 ECC pairs	8Meg/16Meg/32Meg/64Meg	Call
Presario 510 520 524 660 720 724 860	4Meg/8Meg/16Meg/32Meg	17/29/49/79
Presario 920 924 954 9 4 913 992	4Meg/8Meg/16Meg/32Meg	17/29/49/79
Presario 2100 2 2 2200 9200 9260 EDO pairs	4Meg/8Meg/16Meg/32Meg	14/23/39/79
Presario 4112 4114 4116 4 4 EDO pairs	4Meg/8Meg/16Meg/32Meg	14/23/39/79
Presario 4524 4528 4528 SDRAM	16Meg/32Meg	49/89
Presario 4704 4706 4 4 4716 EDO pairs	4Meg/8Meg/16Meg/32Meg	14/23/39/79
Presario 4764 4766 4784 4786 SDRAM	16Meg/32Meg	49/89
Presario 4806 4814 SDRAM	16Meg/32Meg	49/89
Presario 7160 9536 9546 9548 9564 (pairs)	4Meg/8Meg/16Meg/32Meg	17/29/49/79
Presario 9232 9234 9240 9250 9642 9660 (pairs)	4Meg/8Meg/16Meg/32Meg	17/29/49/79
Prolient 1000 5/60 2000 R 4000 R (quads)	4Meg/8Meg/16Meg/32Meg	16/39/54/89
Prolient 1500 1500R (pairs)	4Meg/8Meg/16Meg/32Meg	16/39/54/89
Prolient 4500 4500R (quads)	4Meg/8Meg/16Meg/32Meg/64Meg	16/39/59/89/199
Prolient 5000 5000R (pairs)	32Meg/64Meg/128Meg/256Meg	Call
Prolinea 575 590 5100 5120 5133 (pairs)	4Meg/8Meg/16Meg/32Meg	17/29/49/79
Prolinea 5100 5120 5133 5150 5180 (EDO pairs)	4Meg/8Meg/16Meg/32Meg	17/29/49/79
Prolinea 575E 100E 120E 575MX (pairs)	4Meg/8Meg/16Meg/32Meg	17/29/49/79
Prolinea 590MX 5120MX (pairs)	4Meg/8Meg/16Meg/32Meg	17/29/49/79
Prolinea 5150E 6180E (pairs)	16Meg/32Meg	34/49/79
Prosignia 300 575 590 5/90 5120 5/150 (pairs)	4Meg/8Meg/16Meg/32Meg	16/34/59/89
Prosignia 500 5/90 5/120 5/150 (pairs)	4Meg/8Meg/16Meg/32Meg	16/34/59/89

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Armada 1100 1120T 1120 1125	8Meg/16Meg/32Meg/64Meg	49/69/129/249		184	
Armada 1130 1130T	8Meg/16Meg/32Meg	49/69/139		184	
Armada 1500DM 1550DM	16Meg	69/139/299			
Armada 7300 7350 7400 7450T (pairs)	4Meg/8Meg/16Meg/32Meg	29/49/79/139/299			
Armada 7730 7730T 7750DM	16Meg/32Meg	59/139/230			
Concerto 4125 433	4Meg 8Meg 16Meg	49/69/99		199	
Contura 4/25 4/25C 4/25CX	4Meg 8Meg 16Meg	49/69/99		119	
Contura 400C 400CX 410CX 430CX	4Meg/8Meg/16Meg/32Meg	49/69/99/129		184	
Contura 420C 420CX 430C 430CX	4Meg/8Meg/16Meg/32Meg	49/69/99/129		184	
Contura 4/33	4Meg 8Meg 16Meg	49/69/99		167	
LTE 5400 5100 5200 5300	8Meg/16Meg/32Meg/64Meg/128Meg	39/79/149/299		139	
LTE Elite 4/66C CE 4/75CS	8Meg/16Meg/32Meg	49/69/129/179		139	
LTE Lite 4/25	4Meg 8Meg 16Meg	49/69/99		167	
Presario 1000 1010 1020 1030 1070 1080	8Meg/16Meg/32Meg/64Meg	39/79/149/299		119	217
Presario 1207 1210 1215	16Meg/32Meg/64Meg	69/139/279		117	229

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200c P133c, 166c, 200c SDRAM		
Dimension XPS P60 P75 P90 P100 P120 pairs	4Meg/8Meg/16Meg/32Meg	18/29/49/79
Dimension XPS P133c P166c P200c pairs	4Meg/8Meg/16Meg/32Meg	18/29/49/79
XPS P133 P166 pairs FPM EDO		18/29/49/79
Dimension XPS P133c P166c P200c (quads)	8Meg/16Meg/32Meg	18/29/49/79
Dimension XPS P166c P200c P233c (pairs)	4Meg/8Meg/16Meg/32Meg	18/29/49/79
Optiplex GL GM SMT 133 pairs	4Meg/8Meg/16Meg/32Meg	18/29/44/79
Optiplex GS GXa GXM SMT 133 pairs	4Meg/8Meg/16Meg/32Meg	18/29/44/79
Optiplex GS GXa GXM EDO 133 EDO pairs	4Meg/8Meg/16Meg/32Meg	19/29/44/79
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Canon, BP 430	–	–	10	–	–	–	29	–	–	–	–	–
Canon, BP 860 1260	–	–	14	–	–	–	29	–	39	39	99	–
Epson Action 80, Laser 1100, 1000	–	–	14	19	–	–	29	–	39	39	–	–
Epson Action Laser II	–	–	74	–	139	–	–	149	–	–	–	–
Epson 8000, 1800, 4000, 4100, 4200	–	–	74	–	139	–	–	149	–	–	–	–
Epson 1000 1500 5000 5200	–	–	–	49	–	–	79	–	–	–	–	–
HP 2, 2D–	–	–	–	59	–	–	79	–	–	–	–	–
HP 2 3D 3P 3Pa	–	–	–	59	–	–	79	–	–	–	–	–
HP 4 4M 4Si 4SiMX	–	–	–	59	–	–	79	–	39	–	–	–
HP 6L	–	–	29	–	–	–	49	–	–	–	–	–
HP 6MP 3P	–	–	–	9	10	–	24	–	–	39	–	99
HP 4L 4ML 4V 4MV	–	–	–	9	10	–	24	–	–	39	39	99
HP 5 5M 5MP 5N 5P 5Si 5MX	–	–	–	9	10	–	24	–	–	39	39	99
HP 5L 6L	–	–	–	–	–	–	24	–	–	39	–	99
HP 5MP 5P	–	–	–	9	10	–	24	–	–	39	–	99
HP Design Jet 200 220	–	–	–	–	–	–	29	–	–	44	–	99
HP Design Jet 230 250C	–	–	–	–	–	–	29	–	–	44	–	99
HP Design Jet 330 350C	–	–	–	–	–	–	29	–	–	44	–	99
HP Design Jet 800 850C	–	–	–	–	–	–	29	–	–	44	–	99
HP Design Jet 650C PS	–	–	–	–	–	–	29	–	–	44	–	99
HP Design Jet 700 750C Plus 755	–	–	–	–	–	–	29	–	–	44	–	99
HP Design 500 500C 510 550 560	29	–	–	–	–	–	–	–	–	–	–	–
HP Desket 1200C 1200CPS 1400C 1600CM	–	–	–	–	–	–	29	–	–	44	–	99
IBM Laser 4019 4029	–	–	–	–	–	109	–	–	–	–	–	–
IBM Laser 4029 4037	–	–	–	–	–	–	49	–	–	–	–	–
IBM Laser 4039 4079	–	–	–	79	–	–	49	–	–	89	–	99
Lexmark Optra 1 R R RX	–	–	–	–	–	–	–	–	–	59	59	99
Lexmark Winwriter 300 600	–	–	29	–	39	–	49	–	–	–	–	–
Lexmark Winwriter 200 400 600	–	–	29	–	39	–	49	–	–	–	–	–
Lexmark 5 Series	–	–	–	–	–	–	–	–	–	–	–	199
NEC 90 290	–	–	–	59	–	–	–	–	–	–	–	–
NEC 95 97	–	–	–	59	–	–	–	–	–	–	–	–
Oki 400E 400EX 410E 410EX	–	–	67	99	109	–	149	–	–	–	–	–
Oki 610E EX 600E EX 810E EX	–	–	29	79	–	–	–	–	149	229	–	–
Panasonic 4420/4450I	–	–	–	79	–	–	109	–	–	–	–	–
Panasonic 4410/4430	–	–	–	79	–	–	109	–	–	–	–	–
Panasonic 4400/5400	–	–	–	49	59	–	109	–	–	–	–	–
Panasonic 4440 5410	–	–	–	–	–	–	109	–	–	–	–	–
Panasonic 6500	–	–	14	–	34	–	39	–	–	–	–	–
Sharp 9400 9450 9600 9700E	–	–	49	–	119	–	119	–	–	–	–	–
Sharp 9500 E H 9700 H	–	–	49	–	119	–	239	–	–	–	–	–

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MODEL	AMT UPGRADED	MEMORY PRICE	BAT	NimH	Li-on
Libretto 50CT	8Meg/16Meg	59/99		—	167
Tecra 540CDT, CS 510CDS, CDT 8Meg/16Meg/32Meg/64Meg/128Meg		39/49/129/209/499		281	239
Tecra 550CDT, 550CDS 8Meg/16Meg/32Meg/64Meg/128Meg		39/49/129/209/499		239	
Tecra 700CS 700CT (SDRAM) 8Meg/16Meg/32Meg		59/129/299		279	399
Tecra 710CDT 720CDT 730CDT 8Meg/16Meg/32Meg/64Meg/128Meg		59/99/139/259/499		279	399
Tecra 750CDT 740CDT 8Meg/16Meg/32Meg/64Meg/128Meg		59/99/139/259/499		279	399
T2000SXE	8Meg	79		184	
T2180 Series	8Meg/16Meg/24 Meg	39/49/129		184	
T1900 1950 1960 T4700 T4900 Air Models	4Meg/8Meg/16Meg/32Meg	39/59/99/149		184	
T2400 T3400 T3400CT T3600	8Meg/16Meg	49/174		184/119	199
Satellite 1100CS 1105CS 1110CT 1115CS	8Meg/16Meg/32Meg	59/79/129		184	
Satellite 200CDS 205CDS Series	8Meg/16Meg/32Meg	59/79/129		184	
Satellite 220CDS	8Meg/16Meg/32Meg/48Meg/128Meg	39/49/129/209/479		199	299
Satellite 1400 Series, 7000 Series	8Meg/16Meg/32Meg	59/79/139		199	299
Satellite Pro 440, 460, 480	8Meg/16Meg/32Meg/48Meg/128Meg	49/99/149/209/499		199	299
Portege 300	16Meg/32Meg	89/149			
Portege 650CT 800CT	8Meg/16Meg/32Meg/64Meg	39/49/129/249		—	219

NOTEBOOK, LAPTOP MEMORY

MODEL	AMT UPGRADED	MEMORY PRICE	BAT	NimH	Li-on
ACERNote 720C 730C 740C, 760CX 780CX	4Meg/8Meg	49/64		119	
ACERNote 761 765 767 784 786	4Meg/8Meg/16Meg	29/49/59			
ACERNote Light 350 352 353	4Meg/8Meg/16Meg	29/49/69		147	
ACERNote Light 354 356 358 361 (pairs) add-4Meg/8Meg/16Meg		29/49/69		147	
ACERNote Notebook 910 913 914	8Meg/16Meg	49/59/79			
ACERNote Notebook 950 954 955 957 959 (pairs)	4Meg/8Meg/16Meg	29/49/59			
Ambra N-15 N-180	4Meg/8Meg/16Meg	19/59/99		119	
AST Ascentia 847 847	8Meg/16Meg/32Meg/64Meg	39/64/129/279		194	
AST Ascentia P50	8Meg/16Meg	59/99/149			
AST Ascentia 210 230 350 (pairs)	4Meg/8Meg/16Meg/32Meg	29/39/69/99		—	199
AST Ascentia 800N 810N 900N 910N	8Meg	59/99	105/147	—	167
AST Ascentia 950N	8Meg/16Meg	59/89		—	167
AST Bravo & Explorer	4Meg/8Meg/16Meg	49/79		119	
AT&T Globalyst 130 230 250	4Meg/8Meg/16Meg	24/39/69/189	130/199		
Austin 014 017 122 32 Series	4Meg/8Meg/16Meg	49/79		129	
Austin Edge [illegible]	8Meg/16Meg/32Meg	59/89/199			
Austin Edge [illegible]	8Meg/16Meg	39/69			
Compaq Presario Series 3000 3100 3170	4Meg/8Meg/16Meg	39/69		119	
Compaq Presario Series 4000 4100 4200	4Meg/8Meg/16Meg	39/69		119	
CTX EZ Book 5000, 6000, 7000 Point Series 4Meg/8Meg/16Meg/32Meg		29/39/59/129		139	
DEC Hillside	4Meg/8Meg/16Meg	29/39/69		199	
DEC Hillside [illegible]	4Meg/8Meg/16Meg/32Meg	29/39/69/129			
DEC Hillside VP 520, 525, 535, 545 (pairs)	4Meg/8Meg/16Meg/32Meg	29/39/69		119	
DEC Hillside VP 5100 5120	4Meg/8Meg/16Meg/32Meg/64Meg	39/69/129/299		119	
DEC Hillside VP Cxa L 5S CT5, LT5	4Meg/8Meg/16Meg/32Meg/64Meg	39/69/129/299		119	
Dell Inspiron 3000	32Meg/64Meg	79/149/299			
Dell [illegible]	16Meg/32Meg/64Meg	79/149/299			
Dell Latitude LM (pairs)	16Meg/32Meg/64Meg	29/39/69/149		—	249
Dell Latitude 433 433 CX	4Meg/8Meg/16Meg	49/69		119	
Dell Latitude LX M	4Meg/8Meg/16Meg	49/59/89		199	
Dell Latitude [illegible]	4Meg/8Meg/16Meg/32Meg	29/39/59/149			
Epson ActionNote 850 860c 880c 880cx	4Meg/8Meg/16Meg	19/59/69		119	
Epson ActionNote 880 886c 890 916	4Meg/8Meg/16Meg/32Meg	29/49/79/169		119	
Epson ActionNote 4LC 25 4LC33 4SLC2 50 4200	4Meg	69/99		79	
Fujitsu Lifebook 500 800 Series only	8Meg/16Meg/32Meg/64Meg	39/59/129/239		199	239
Fujitsu Lifebook Curve Montego Mitlar	8Meg/16Meg/32Meg/64Meg	59/129/299/479		199	239
Gateway 2000 Colorbook 433	4Meg/16Meg	59/179		112	
Gateway 2000 [illegible] pairs	4Meg/8Meg/16Meg	29/39/69			
Gateway Solo Series 2100 2200 edo	8Meg/16Meg/32Meg	59/119/209			
Gateway Solo 9000 9100 2500	16Meg/32Meg/64Meg	59/119/279			
Hitachi C series	8Meg/16Meg/32Meg	39/59/129			
Hitachi E Series MX Series	8Meg/16Meg/32Meg	39/69/149		119	
Hitachi M Series	8Meg/16Meg/32Meg	59/99/149		184	
Hitachi Visionbook	8Meg/16Meg/32Meg/64Meg	39/59/149/239		184	277
IBM [illegible]	8Meg/16Meg/32Meg/64Meg	39/69/149/259		—	149
HP Omnibook 4000C CT C	4Meg/8Meg/16Meg	49/59/89		139	
HP [illegible]	8Meg/16Meg/32Meg	59/79/129/259		139	
Micron Millenia Transport Pentium pairs	4Meg/8Meg	49/69			
Midwest Micro Elite or Soundbook Plus or Studio II	8Meg/8Meg/16Meg	49/69/149		119	
Midwest Micro [illegible]	8Meg/16Meg	49/69/129			
NEC Ultralite Versa E V MP	4Meg/8Meg/16Meg/32Meg	49/69/149/249		139	
NEC Versa S Versa 2000C, D 2200C	8Meg/8Meg/16Meg	29/49/89		169	
NEC Versa 2400 Series 2530 2535	8Meg/16Meg	49/79		169	
NEC [illegible]	8Meg/16Meg	49/69/139			
NEC Versa 4000 4050 4080 4200 4230 4Meg/8Meg/16Meg		49/69/89/139			
NEC Versa 6000 6030 8Meg/16Meg/32Meg/64Meg		59/89/149/259			
NEC Versa 6050 8Meg/16Meg/32Meg/64Meg		59/89/149/259			
Packard Bell Statesman	2Meg/8Meg	39/69		169	
Panasonic CF V71P CF 530	8Meg/16Meg	49/84		139	
Panasonic CF V41P Series	4Meg/8Meg/16Meg/32Meg	49/59/84/139		139	
Sager Mobiform all models	4Meg/8Meg/16Meg/32Meg	29/49/69/239		249	
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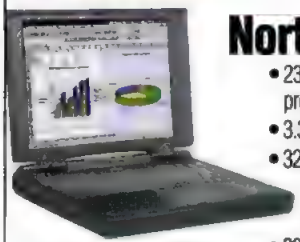

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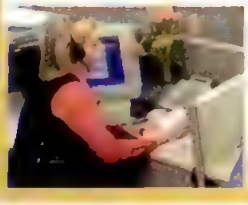

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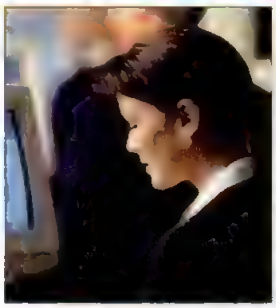

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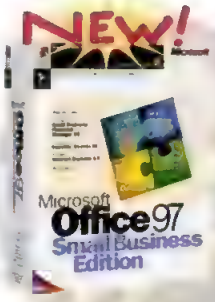

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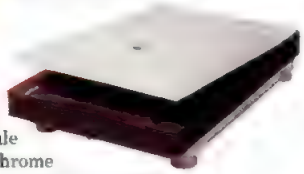

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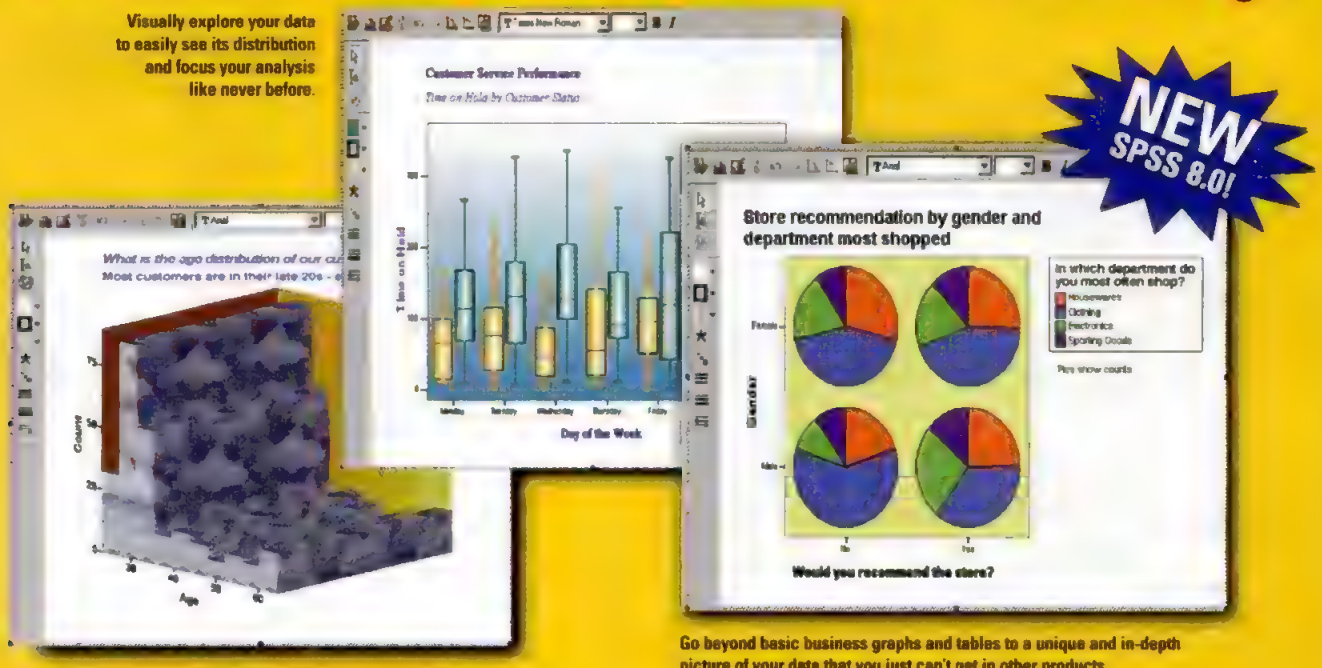

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HARDWARE	PREMIER	CLASSIFIED
Batteries	348	
Boards/Components/Chips	334	348
Communications	334	
Computer Systems	336	349
Input/Data Acquisition/Barcode/POS	339, 343, 350	
Maintenance & Cleaning	339	
Mass Storage Devices	341	
Networking	338	352
Peripherals	338	352
Video	333	

SOFTWARE	PREMIER	CLASSIFIED
Business Applications	342	353
Business Utilities	347	353
Communications	344	
Education	345	353
Financial	341	
Foreign Lang/Font	342	
General	353	
Graphic/Design/CAD	342	
Internet Tools	353	
Multi-Media	340	

SOFTWARE (con't)	PREMIER	CLASSIFIED
Security	354	
Shareware/Public Domain	344	
Adult	356	
SERVICES		
Data Conversion/Data Recovery	354	
On-Line	344, 346	
Software Duplication	354, 357	
MISCELLANEOUS		
Supplies	356	

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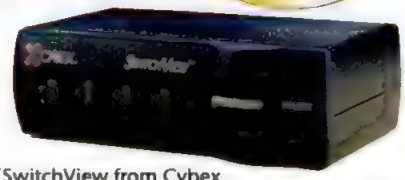

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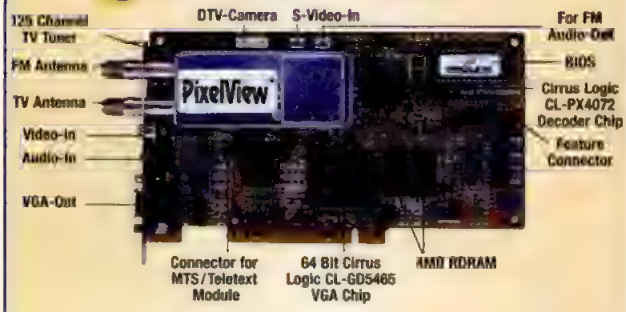

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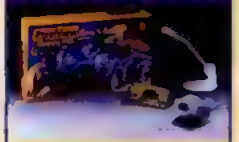

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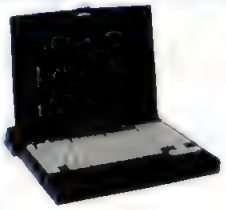

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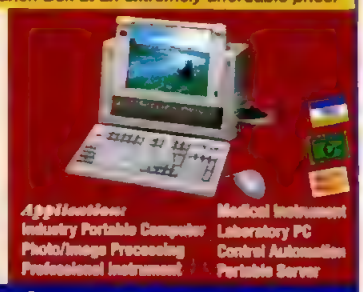

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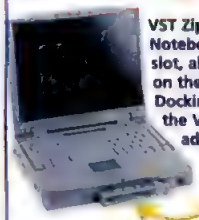

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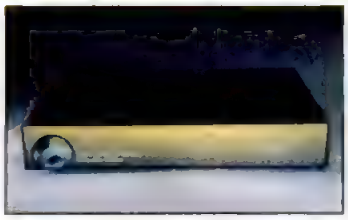

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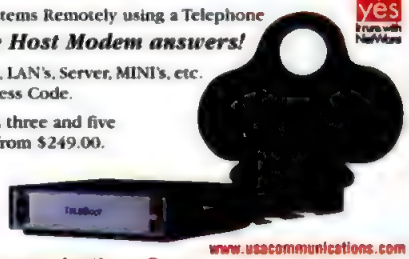

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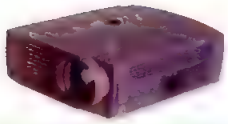

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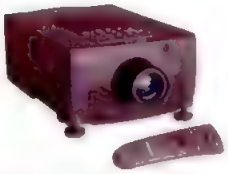

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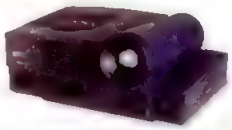

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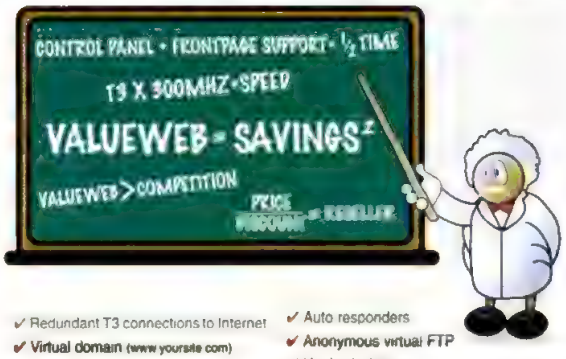

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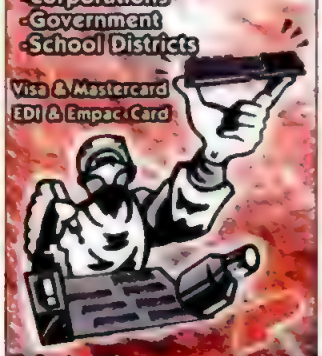

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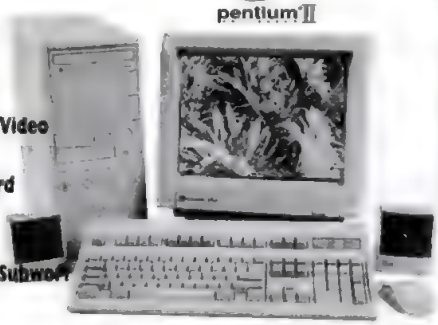

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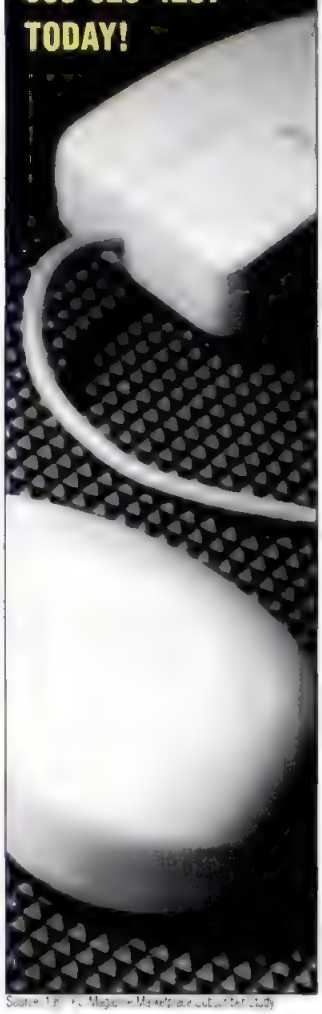

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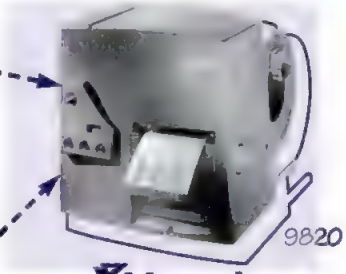

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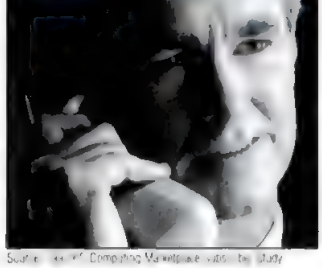

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After Hours

Web Excursions

The Web can be your guide to the best bed-and-breakfast accommodations.

By Jennifer Triverio

Summer's fast approaching, and there's no better time than the present to start thinking about your vacation plans. Sure, magazine and television ads tout the pleasures of visiting such popular locales as Las Vegas and Walt Disney World, but if you're looking for a memorable getaway at a quaint little bed-and-breakfast, the Internet is your perfect tour guide.

Bed-and-breakfasts have become a popular choice for those looking for an alternative to a touristy hotel or a cookie-cutter roadside motel. Most offer cozy accommodations, usually accompanied by tasty home cooking. Since for the most part, these inns don't have the advertising budget of big hotels, the Internet is the ideal way for them to make themselves known. We pored over dozens of sites and offer you four of our favorites, based on depth and breadth of content.

Earlier this year, we reviewed options for travel planning on the Web ("Be Your Own Travel Agent," January 6, 1998). We noted that, while there are plenty of quality sites for business travelers, there is a dearth of top-notch vacation information online. So in addition to the B&B sites, we revisited some of these other travel sites to see what's new in vacation planning.

Bed and Breakfast Network

Whether you're looking in Maine or Hawaii, the Bed and Breakfast Network aims to link you with the B&B that best complements your vacation. This directory lists more than 12,000 guest houses nationwide and has several other features that make it a site worth visiting.

Of course, the main focus is the lodging, but let's first take a look at some of the other areas of interest. B&Bs are known for their food: It's not often you get still-warm muffins with homemade jam or fresh-baked sticky buns from a hotel. The Bed and Breakfast Network serves up some of the great recipes these inns are famous for, such as Apples & Spice Baked Toast from the Village Green Inn in Massachusetts and Old West Orange Croissants from the Boots & Saddle in Arizona. The Festivals and Events section links to upcoming jazz festivals, fairs, and sporting events. And in case you are interested in getting into the business, the For Sale section lists B&Bs on the market.

On to the B&Bs: You can search the database by city and state or browse the "featured" inns, which are listed by state. It's here that you notice that information is a bit inconsistent. Data on each featured house includes an overview of the accommodations, a photo, rules of the house (whether pets are allowed, for example), and comments from former guests. Noticeably lacking from some of the descriptions are room rates, although most other sites seem to provide this information.

For B&Bs that are not featured houses (generally inns in less-traveled states such as Utah or South Dakota), information is decidedly sparse and consists of just a name, phone, address, and map.

Overall, however, the information and photos make for pleasant browsing.

Inns&Outs

Started in 1994 by a husband-and-wife team who were having difficulty finding reliable information about bed-and-breakfasts, Inns&Outs currently supplies visitors to the site with the lowdown on over 20,000 inns worldwide.

The opening screen of Inns&Outs is a straightforward search engine. You can begin by entering a city, state, or country that you wish to visit (from the U.S. to Malta; this site is expansive). Or if you prefer to browse first, click on the Bed and Breakfast Channel, an online magazine of sorts that spotlights B&Bs and events. On a visit in March, for example, it was fea-

INSIDE

PINBALL WIZARD

Prove your pinball prowess with these two simulation games. *Page 366.*

AFRAID OF THE DARK?

Join Nightmare Ned on a wacky trip through dreamland. *Page 370.*

STAR FIGHTER

Fly battleships and confront aliens. *Page 370.*

Planning a Trip? Visit the Web

Smart business travelers know that the Internet is a handy tool for planning trips, booking air fares, and reserving hotels. Those wanting to plan a vacation online have been less fortunate. In most cases, Web travel sites are business-oriented and overlook the needs of vacationers. There are, however, a few notable exceptions.

Arthur Frommer's Outspoken Encyclopedia of Travel

Travelers familiar with the *Frommer's USA* travel guides realize that Frommer's listings of activities, hotels, and restaurants nationwide are an invaluable resource for getting the most out of their excursions. Frommer's online site (*www.frommers.com*) is a worthy companion to the books. As the site says, 200 cities and islands account for more than 80 percent of our vacation travel. All 200 destinations are covered in depth here. This is a great place for those seeking budget travel info as well as those looking for a trip that's off the beaten path. Travel news is updated daily via the online newsmagazine Vacations for Real People, and the travel message boards are diverse and active. The site is divided into four main categories: Vacations, Booking Travel, Savvy Travel, and Issues & Ideas. Destination recommendations, hotel and cruise information, and plenty of tips from experienced travelers can be found here. And when you actually want to book your trip, you're linked to the Travelocity Web site.

Fodor's Travel Online

Fodor's Travel Publications has hundreds of travel guides in print and a long-established reputation for excellence in the field. It seems a natural progression for the company to move its resources to the Internet, which it has done admirably at Fodor's Travel Online (*www.fodors.com*). The highlight of the site is the Personal Trip Planner, which invites you to map out vacation plans for any of 87 cities around the globe. The Personal Trip Planner leads you through a series of questions to ascertain what you are looking for in the way of destination, hotel accommodations, restaurants, activities, and transportation options. The information is then compiled into a portable, personalized travel guide that you can print out and take with you on your trip. You'll also find detailed restaurant and hotel reviews, message boards, and travel articles. Reservations can't be made at the site, but there is a link to Preview Travel, which accepts online reservations for air, hotel, and car. Visit the Resource Center to find the link.

turing guest houses and attractions in San Antonio, Texas, home to this year's Final Four basketball tournament.

From the Bed and Breakfast Channel, you can also perform searches by location, keyword, or amenities (is there a fireplace, a Jacuzzi, or nearby horseback riding?). While there are some B&Bs for which detailed information is not provided, in general Inns&Outs offers comprehensive, well-laid-out facts, figures, and photos for each house. From listings of room amenities and nearby attractions to the description of a house's architecture, Inns&Outs gives plenty to help you decide which inn will make for the best vacation.

Once you've found a B&B to suit you, the site provides links to car rental and airline bookings, interactive maps of the area, weather information, and a list of any special deals that the inn may be offering. There's also a message board (still under construction as we went to press) for travelers to share their ideas and opinions about B&B sojourns.

Inns&Outs certainly delivers easy access to the facts and figures of B&Bs.

THE MINING COMPANY: BED AND BREAKFASTS
The Mining Company, 212-343-2000,
bandbminingco.com.

The Mining Company: Bed and Breakfasts

For the uninitiated, The Mining Company is a Web site (*miningco.com*) where experts in a chosen field host an online discussion area devoted to their topics. Currently, the site is home to about 500 topic areas, from amateur sports to parenting—and of course, bed-and-breakfasts.

Unlike the other sites we reviewed, The Mining Company isn't a database of guest houses from coast to coast. Don't be mistaken: It does have listings of top-notch B&Bs, but they aren't listed simply by city or state. Instead, this comparatively small group of inns is divided into specialty categories: Vegetarian inns, inns near golf courses, pet-welcoming inns, and "haunted" B&Bs are among the highlighted facilities. These 15 categories really set the site apart and let you tailor your lodging to your tastes. Listings for the inns include accommodation details, photos, and descriptions of any special features.

If you've visited any of the B&Bs mentioned, you are welcome to submit your comments about your stay. The Mining Company experts also make their recommendations (though it seems as if they've been traveling only on the East Coast).

In addition to the listings,

the hosts of the Bed and Breakfasts site provide regularly updated feature articles on related topics, such as becoming an innkeeper as a post-retirement career. A chat room and bulletin board—although not the liveliest communications areas we've seen on the Web—keep you in touch with lots of fellow travelers.

The Mining Company digs deep through the material on the Web to offer up the best B&Bs.

Triple One Travel Directory

Curiously, Triple One Travel Directory dubs itself the "bed-and-breakfast, vacation rental, and adventure travel tour operator" of the Internet. We couldn't seem to find the adventure tours and vacation rentals at this site. Yet the bed-and-breakfast information makes it worth a visit anyway.

The home page of Travel One, with its numerous links and buttons to click, can be overwhelming. To begin, we suggest clicking on Find and then choosing an area of the world you're interested in visiting. For each state or region (such as the islands of the Caribbean), there are a number of Featured and Regular B&B listings.

The Featured listings have detailed information about the accommodations: a photo, an overview, and pricing, as well as the requisite address and phone number. The Regular listings, however, just give the bare minimum. Unfortunately, there are more Regular than Featured listings (you're especially likely to find only Regular listings for inns outside the U.S. and Canada).

Back on the home page, be sure to visit the Travel Tips section, which offers dozens of user-submitted pieces of advice on everything from traveling with kids and pets to packing. (A tip from the site: If you are traveling with someone and bringing two bags, pack half of each person's clothes in each bag. If one bag gets lost, at least you have half of your things). Also of note is the Cool Links area, which hooks you up with a foreign-currency calculator, the weather forecast, and online maps for plotting your trip.

Triple One is a worthwhile pit stop on your road to vacation planning.

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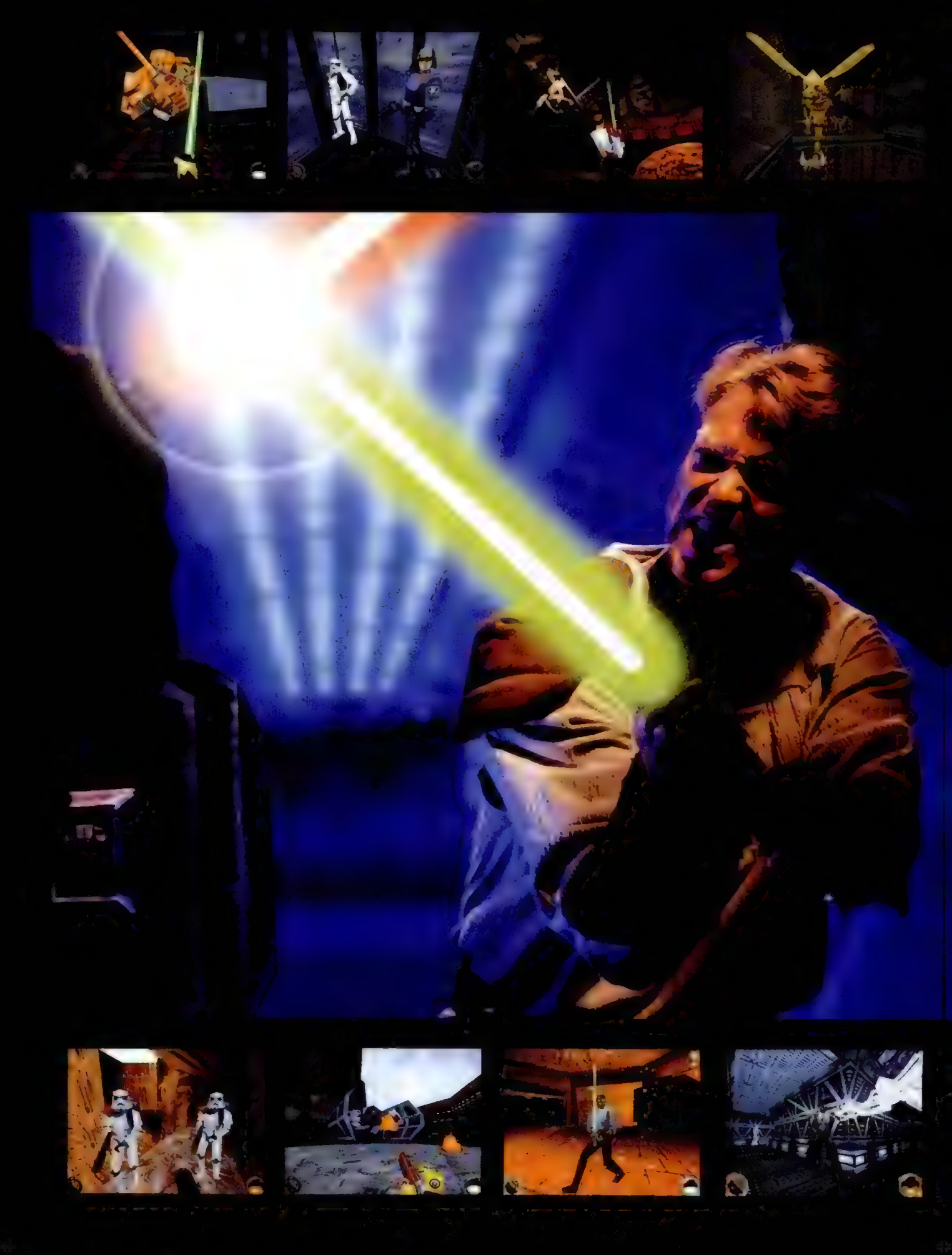

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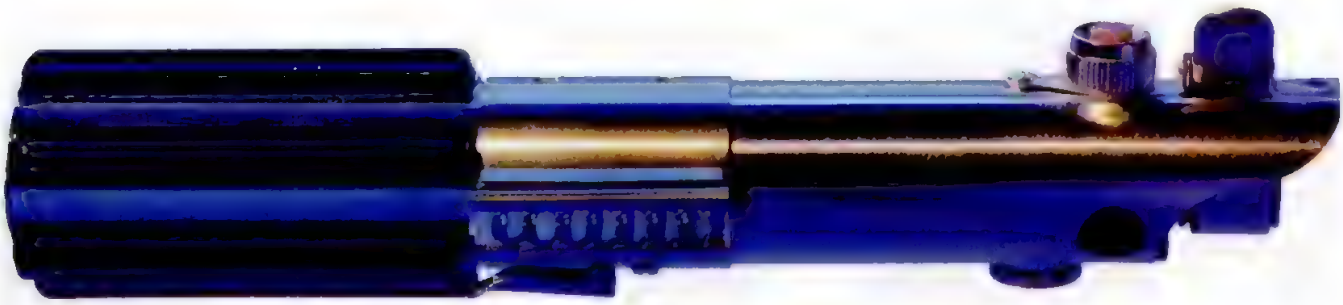
- PC Magazine



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Pinball Power

A look at two pinball games that provide the excitement of the real thing.

Playing pinball on the computer may seem, at best, a poor alternative to the real thing. Where is the visceral thrill of slamming the ball into action or trying to tilt the entire machine physically in order to gain those extra points? In the past, PC-based pinball games were colorful and included many levels, but the excitement was often absent. Now two unique new games try to purge these unfair notions about PC pinball.

3-D Ultra Pinball: The Lost Continent

Sierra On-Line's 3-D Ultra Pinball: The Lost Continent has taken the realism that computer pinball lacks and turned it into an advantage. It dismisses any thoughts of recreating an actual pinball game and instead leads you on an adventure where your goal is to master a variety of pinball games.

Play begins as you join adventurer Rex Hunter and his friends on a jaunt through the jungle, where you face rugged terrain as well as 16 complex pinball games complete with moving targets, monsters, and traps.

Trying to manipulate multiple flippers, keep track of the balls, and extricate the group from danger is tricky yet enjoyable. Some of the adventures are a bit simplistic, but overall the action is satisfying.

You can play The Lost Continent alone or with up to four players (each taking turns—this is not a network game). Graphics are extremely colorful, lively, and well designed, with extra-wide pinball tables that eliminate the need for scrolling side to side. For beginners, multimedia on-screen help provides tips on how to make the tough shots, as well as strategic hints. There's also a worthwhile practice mode that lets you focus on and conquer specific areas of difficulty so that you won't be repeatedly thwarted during game play.

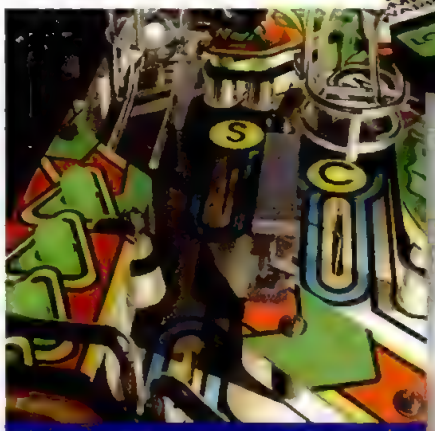
Logically, the game requires the use of the keyboard to simulate the flippers of an actual machine. Unfortunately, the game forces you to choose the smaller keys for the flippers.

3-D ULTRA PINBALL: THE LOST CONTINENT
★★★☆☆ $45 street. Sierra On-Line, 800-757-7707, www.sierra.com.

The Lost Continent might not appeal to die-hard pinball enthusiasts who demand realism above all. But for action, variety, fun, and an open-minded reinterpretation of the principles of pinball it's a very attractive choice.—*Sharon Nash*

Pro Pinball: Timeshock!

For the traditionalists among pinball fans, Pro Pinball: Timeshock! is a gift. The game provides unbelievably realistic effects. The theme is time travel: Players journey through time collecting souvenirs, which singly or in combination earn bonus points, extra balls, or extra gaming levels.



PRO PINBALL: TIMESHOCK!
★★★★☆ $40 street. Empire Interactive, 415-439-4854, www.empire-us.com.

Timeshock! is based on a wide-body pinball design, and the representation of the balls (up to six in play at a time) is flawless. Unfortunately the animated adventures (portrayed in a dot-matrix display) don't add much to the overall experience. The play is so realistic that you truly feel pulled into the game, and trying to make out the grainy animations distracts from this experience.

For the pinball nerds, a full operators' menu provides access to detailed statistics on every aspect of the game, as well as the opportunity to test or alter various features. The menu offers full control over the table hardware, allowing you to flash the lights, fire the solenoids, test the flashers, or do anything else that's feasible on a real table.

Timeshock! is something of a memory hog, and the installation is long, but the results are more than worth the wait. Every detail of the table has been painstakingly recreated. From the fluidity of the balls—it seems as if they may crash through the screen at any moment—to the highly realized 3-D effects, Timeshock! is a pleasure to look at.

Timeshock! offers four different modes of play: novice, regular, challenge, and tournament. Novice gives the player only one ball but guarantees at least 2 minutes of play time and makes some features easier. Unless you are an experienced player, you'll want to begin at this level.

Timeshock! provides an intense pinball experience that sets the standard for graphical excellence and elegance while remaining extremely enjoyable to play.—*SN*

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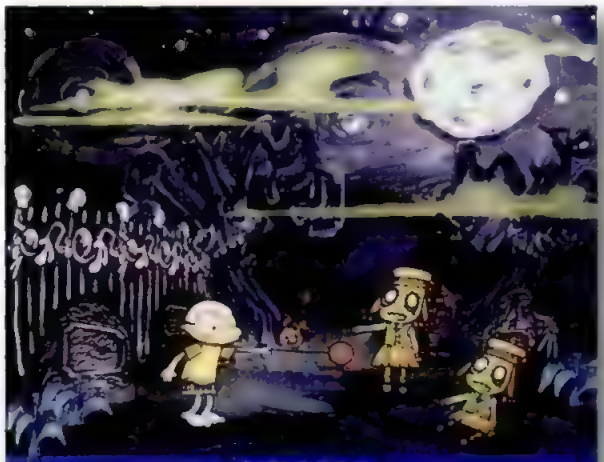
Cartoon Demons

Battle zombies, ghouls, and the school nurse with Nightmare Ned.



NIGHTMARE NED
★★★★ $35 street. Disney Interactive, 800-328-0885, www.disney.com/DisneyInteractive/.

Nightmare Ned

Ned Needlemeyer's got a lot to be afraid of: the school bully, the dentist's office, and all those smelly things in the attic. They terrify him enough during the day, but at night they enter his dreams and scare him a whole lot more.

Welcome to Nightmare Ned, a twisted little game that will have kids and adults alike laughing out loud. Starting from his bed (where bad dreams begin) and armed only with a red yo-yo, Ned explores five nightmare worlds: the school, bathroom, hospital, graveyard, and attic. Along the way he battles goblins, a vindictive principal, and zombie Girl Scouts. He loses almost as often as he wins, but that's no matter: Ned just shakes off his injuries and keeps on exploring. After all, this is only a dream.

The team making Nightmare Ned obviously had a good time. It shows in every loopy detail, as when Ned's badly made art projects come to get him. The rich, swirling graphics are a treat, as are the clever songs. We especially like the one the sewer mice sing as they try to electrocute Ned with electric beavers (yes, electric beavers). Listen for the voices of Harry Anderson, Jeff Cesario, Edie McClurg, and Kathy Najimy.

Nightmare Ned is recommended for 7- to 11-year-olds. Younger kids may have a hard time completing the game, but they should enjoy guiding Ned around just the same. They may have trouble using two-button keyboard commands for such things as going up and down stairs, however.

A few of the scenes that you need to finish correctly to win the game are frustratingly difficult. Don't discard the manual: it contains essential tips, but it should provide more.

Nightmare Ned is loaded with jokes for adults, too—like one sly reference to *Trainspotting* (a sign reading "the worst toilet in Ned's nightmare"). Certain to keep everyone entertained, this game is a great purchase for the whole family.—*Troy Dreier*

Stellar Space Combat

Wing Commander V strikes graphics gold.

WING COMMANDER PROPHECY
★★★ $55 street. Origin Systems, 800-245-4525, www.origin.ea.com.

Wing Commander Prophecy

If you still don't think you need a 3-D accelerator board, a few minutes playing Wing Commander Prophecy will change your mind. The fifth installment in the Wing Commander series, it features dazzling 3-D graphics and space combat thrills. The game's intense action overrides the fact that the story is somewhat lacking.

With a 3-D card, you can run Prophecy on a Pentium/133 with 32MB RAM and at least 150MB of hard disk space. The game offers native support for 3Dfx cards and uses Direct3D to support the ATI Rage Pro, Matrox Mystique, Permedia 2, Rendition V2200, and Riva 128 chip sets. Without a 3-D card, you can still play as long as you have a Pentium/166 or better.

Prophecy is a game of space combat interspersed with live-action sequences. Each of the 35 combat missions is a challenging sortie against a race of insect-like aliens. These nameless creatures have already decimated Kilrathi forces (humanity's foe in Wing Commanders I through III); now they've set their sights on you and your comrades. Flying a variety of fighter and attack craft, you must defeat them and destroy the massive gateway they've constructed to enter your galaxy.

While in the cockpit, you'll marvel at Prophecy's graphics and fast-paced action. Each of the ships is exquisitely detailed. The explosions are unbelievable, and 3-D acceleration adds colored lighting and lens-flare effects. The alien ships are suitably creepy and move in unpredictable ways.

Between missions, however, the game lacks the drama of past versions. The dialogue is corny, and the aliens, who could have been terrifying, are never fully developed. Also, Origin Systems pulled the plug on the game's eagerly anticipated multiplayer option at the last minute.

Still, Wing Commander Prophecy is a breakthrough in terms of graphic detail and action. Would-be star-pilots with itchy trigger fingers will enjoy it.—*Michael E. Ryan*

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Product Company — **Page No.**/Infolink

The Bat! RITLabs S.R.L. ... **113**/526
Bryce 3D MetaCreations Corp. ... **66**/401

Calypso E-mail Micro Computer Systems Inc. ... **117**/518
Compaq Armada 7800 Compaq Computer Corp. ... **45**/
Compaq Deskpro 4000N Compaq Computer Corp. ... **224**/
CompuServe Mail CompuServe Interactive Services Inc. ... **120**/519
Crystal 3D Impact! Pro CrystalGraphics Inc. ... **66**/402

Data Widgets 3.0. Sheridan Software Systems Inc. ... **277**/528
dbComplete 1.5 Sybase Inc. ... **277**/529
Dell Inspiron 3200 D266XT Dell Computer Corp. ... **45**/412
Dell Latitude CPi D266XT Dell Computer Corp. ... **45**/412
Dell OptiPlex N Dell Computer Corp. ... **224**/548
Diva T/A ISDN Modem Eicon Technology Corp. ... **76**/406
DynamiCube 2.0 Data Dynamics Ltd. ... **278**/530
email 97 E Corp. ... **128**/520
Eudora Pro Email 4.0 Qualcomm Inc. ... **128**/500
Eudora WorldMail Server 2.0 Qualcomm Inc. ... **161**/500

FastTrack Schedule 5.02 AEC Software ... **68**/405
Full Armor Zero Administration Micah Development Corp. ... **240**/900

Gateway 2000 E-1000N 233 Gateway 2000 Inc. ... **228**/549
GridWiz OCX 3.54 McRae Software International Inc. ... **280**/531

HP Net Vectra Hewlett-Packard Co. ... **229**/508

IBM ThinkPad 600 51U IBM Corp. ... **45**/413
IBM ThinkPad 770ED IBM Corp. ... **45**/413
IMail Server 4.0 for Windows NT Ipswitch Inc. ... **162**/501
Infinite InterChange 3.10 Infinite Technologies ... **162**/502

Java Web Server 1.1 Sun Microsystems Inc. ... **187**/555

KeyText 1.0 MJMSoft Design Ltd. ... **76**/407

Lexmark 5700 Color Jetprinter Lexmark International Inc. ... **68**/404
Lotus Domino 4.6a Lotus Development Corp. ... **171**/512
Lotus Domino Go Webserver Pro 4.6.1 Lotus Development Corp. ... **190**/556
Lotus Mail Lotus Development Corp. ... **129**/512
Lotus Notes Designer 4.6a Lotus Development Corp. ... **171**/512
Lotus Notes Desktop 4.6a Lotus Development Corp. ... **171**/512

MailCat 2.7 Black Paw Communications ... **129**/522
MailSite SQL Enterprise 2.1.5 Rockliffe Systems Inc. ... **163**/503
Manage Exec 5.0 Seagate Software ... **262**/905
Mercur 3.0 Atrium Software ... **164**/504
Microsoft Exchange Server 5.5 Microsoft Corp. ... **172**/513
Microsoft Internet Information Server 4.0 Microsoft Corp. ... **192**/557
Microsoft Outlook 98 Microsoft Corp. ... **130**/513
Microsoft Outlook Express 4.0 Microsoft Corp. ... **130**/513
Microsoft Zero Administration Kit Microsoft Corp. ... **240**/901

Product Company — **Page No.**/Infolink

Neoware @workStation Supra-66 Neoware Systems Inc. ... **218**/542
Netscape Enterprise Server Standard Edition 3.5.1 Netscape Communications Corp. ... **194**/559
Netscape Messaging Server for NetWare Novonyx Inc. ... **164**/505
Netscape Messenger 4.0 Netscape Communications Corp. ... **151**/514
Netscape SuiteSpot 3.5 Netscape Communications Corp. ... **178**/514
Novell GroupWise 5.2 Novell Inc. ... **180**/511
Novell Netscape Enterprise Server Pro for NetWare Novell Inc. ... **195**/558
N-Plex Office 1.31 Isocor ... **168**/506
NTMail 3.03C Internet Shopper Ltd. ... **168**/507

OmniForm 3.0 Caere Corp. ... **56**/411
OpenMail 5.10 Hewlett-Packard Co. ... **169**/508

Philips DVX8000 Multimedia Home Theater Philips Digital Entertainment Group ... **62**/408
Picture Publisher 8 Micrografx ... **73**/403
Plasmavision 42EP Fujitsu General America Inc. ... **79**/400
Projectavision Digital Home Theater Projectavision ... **62**/409
ProntoMail Professional Edition CommTouch Software Inc. ... **151**/523

QuickMail Pro 1.5.2 CE Software Inc. ... **153**/524

Red Hat Linux 5.0 for x86 Red Hat Software Inc. ... **186**/554

Server Technology Sentry R-2000 Server Technology Inc. ... **257**/904
Sherwood Passport Sherwood USA Corp., Sherwood Network Division ... **229**/551
Simeon Message Service 2.0.1 The ESYS Corp. ... **169**/509
Spread 2.5 FarPoint Technologies Inc. ... **280**/532
Sun Internet Mail Server 3.2 Sun Microsystems ... **170**/510

TeamWare Embla 2.1 TeamWare Group ... **154**/525
TeamWare Office 5.1 Fujitsu Software Corp. ... **183**/515
Tektronix ThinStream 215 Tektronix Inc. ... **219**/543
Toshiba Satellite Pro 490XCDT Toshiba America Information Systems Inc. ... **45**/414
Toshiba Tecra 780DVD Toshiba America Information Systems Inc. ... **45**/414
3Com Palm III Palm Computing Inc. ... **56**/410
True DBGrid Pro 5.0 Apex Software Corp. ... **280**/533

vsFlex 3.0 (Build 036) Videosoft ... **284**/534

WebSite Professional 2.1 O'Reilly & Associates Inc. ... **196**/560
WebStar 3.0 StarNine Technologies Inc. ... **197**/561
WebTen 2.0 Tenon Intersystems ... **208**/562
Wyse Winterm 2310SE Wyse Technology ... **219**/544
Wyse Winterm 2510SE Wyse Technology ... **219**/544

XGrid 4.0 GreenTree Technologies Inc. ... **285**/535

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ADVERTISERS' INDEX BY COMPANY

Infolink No	Advertiser	Page
134	01 Communique Laboratory Inc.	263
*	3 Com Corporation	248
*	3 Com Corporation	256
056	A Trend Technology	281
235	AMS Tech	41
030	A.T. Cross Company	78
*	AT & T WorldNet	293-295
087	Acer America	177
*	Adaptec	57
373	Advanced Modular Solutions	266
108	Akia	193
342	American Power Conversion	31
162	American Power Conversion	267-269
062	Amertek	252
113	ArcSoft	360
*	Arlington Computer Products	302
*	Avery Dennison	288
246	Barnes & Noble	32-33
*	CTX International	230
029	Canon Computer Systems	22-23
*	Canon, U.S.A.	118-119
177	Cardiff Software	287
*	Compaq Computer Corporation	74-75
*	CompUSA PC	198-199
*	CompUSA Direct	324-324B
348	Computer Associates	270
360	COMPUTER DISCOUNT WAREHOUSE	189
159	COMPUTER DISCOUNT WAREHOUSE	190-191
129	COMPUTER DISCOUNT WAREHOUSE	254-255
158	COMPUTER DISCOUNT WAREHOUSE	327
109	COMPUTER DISCOUNT WAREHOUSE	328-329
133	COMPUTER DISCOUNT WAREHOUSE	330-331
011	Corel Corporation	95
203	Crucial Technology	67
138	DPS, Inc.	291
051	Data Comm Warehouse	261
*	Dell Computer Corporation	C5-C8
*	Dell Computer Corporation	54-55
*	Dell Computer Corporation	90-91
*	Dell Computer Corporation	104-105
*	Dell Computer Corporation	170A-170B
*	Dell Computer Corporation	203
*	Dell Computer Corporation	214-215
*	Dell Computer Corporation	279
*	Dell Computer Corporation	311
*	Diamond Multimedia Systems	156
*	Digital Equipment Corp.	110
240	ESRI	274
004	Epson America	12-13
211	Executive Software	282
152	Fluke Corporation	259
099	Gateway 2000	48A-49
104	Gateway 2000	121-127
126	Hayes Microcomputer Products	242
*	Hewlett Packard	138-150
*	Hewlett Packard	92
140	Hitachi	286
184	iiyama Direct	44
084	iiyama North America	86
*	Imation	60-61
390	In Focus Systems	96
278	Insight	204
*	Intel Corporation	25
*	Iomega Corporation	15
*	Iomega Corporation	136-137
058	Ipswitch	250
295	J&R Computer World	312-313
106	Kingston Technology Corporation	84
019	L.A. Trade	321
*	Lucas Art Entertainment	364-365
*	MacMillan Publishing	175
039	MAG InnoVision	18-19
380	Matrox Graphics Inc.	100
191	Meridian Data	246-247
027	Micro Solutions Computer Products	310
003	Micro Warehouse	316-317
013	Micron Electronics	5
098	Micron Electronics	16-17
164	Micron Electronics	36A-36N
119	Micron Electronics	235-238
397	Microsoft	2-3
393	Microsoft	58-59
187	Microsoft	108-109
237	Miller Freeman	227
*	Mita Copystar	20
*	Mitsubishi Electronics	179
155	NEC CSD	80-81
156	NEC CSD	82-83
153	NEC CSD	114-115
154	NEC CSD	220-221
157	NEC Technologies	C2-C4, p1
*	NetObjects	273
299	Network Associates	155
046	Nvidia	50-51
*	Oracle Corp.	11
047	PC Connection	308-309
330	PC Mall	318-319
080	PC Power & Cooling Systems	94
068	PC Zone	322-323
209	Panda Software	265
151	Philips Electronics	160
*	Pitney Bowes, Inc.	290
239	Plextor	297
176	PowerQuest Corp.	209
173	Premio Computers	34
148	Primavera	72
287	ProGen	98-99
132	Proxima	283
383	Puma Technology Inc.	296
024	QMS	264
074	Quantex	131-133
230	Quarterdeck Corporation	292
229	Quarterdeck Corporation	292A
228	Quarterdeck Corporation	292B
227	Quarterdeck Corporation	292C
337	RadioLAN	251
*	REAL 3D	368-369
127	Ringdale	260
309	S.A.G./Storage Solutions	38-39
*	SPSS, Inc.	332
247	STB, Inc.	8
374	Seagate Software NSMG	243
*	Silicon Graphics	43
*	Silicon Integrated Systems	292D
*	Sony Computer Products	70-71
335	Sun Microsystems	69
315	Syquest Technology	174
*	Tektronix Inc.	225
066	TigerDirect	377
377	Toshiba	26-27
242	UMAX Technology	165
241	UMAX Technology	167
243	Viagrafix	289
117	ViewSonic	64-65
118	ViewSonic	88
*	Whistle Communications	253
085	Winbook	77
352	ZD Comdex & Forums	367
*	ZD Net	226

*No Infolink#.Please Call Advertiser For More Information.

Infolink No.	Company	Product	Page
	ACCELERATOR BOARDS		
*	REAL 3D	3D Graphics Boards	368-369
247	STB, Inc	Accelerator Boards	8
	ADD-ON BOARDS		
056	A Trend Technology	Motherboard	281
247	STB, Inc	Accelerator Boards	8
	ANTI-VIRUS SOFTWARE		
209	Panda Software	24h-365d Antivirus Insurance	265
	BACKUP SOFTWARE		
*	Digital Equipment Corp	Storage Works	110
	BOOKS		
*	MacMillan Publishing	Teach Yourself	175
	BRIDGES/ROUTERS/GATEWAYS		
062	Amertek	Amertek	252
	CD-ROM		
151	Philips Electronics	Philips OMNI/12	160
239	Plextor	CD-ROM Drive	297
	CHIPS/PROCESSORS		
106	Kingston Technology Corporation	Memory	84
	CLIENT SERVER SOFTWARE		
*	Whistle Communications	InterJet	253
	COMMUNICATIONS SOFTWARE		
*	Quarterdeck Corporation	DiskClone	292C
*	Quarterdeck Corporation	ViruSweep	292A
*	Quarterdeck Corporation	CleanSweep	292B
134	01 Communique Laboratory Inc	Communicate! Pro	263
*	Quarterdeck Corporation	RealHelp	292
374	Seagate Software NSMG	Seagate Software-NSMG	243
	COMPUTERS/COMPATIBLES		
235	AMS Tech	Rodeo Notebooks	41
087	Acer America	TravelMate	177
108	Akia	LCD System	193
*	Arlington Computer Products	Mail Order, Peripherals	302
*	CompUSA PC	CompUSA PC	198-199
*	CompUSA Direct	Mail Order	324-324B
360	COMPUTER DISCOUNT WAREHOUSE	Hardware	189
159	COMPUTER DISCOUNT WAREHOUSE	Hardware	190-191
109	COMPUTER DISCOUNT WAREHOUSE	Hardware	328-329
133	COMPUTER DISCOUNT WAREHOUSE	Hardware	330-331
*	Dell Computer Corporation	Notebooks, Dimension & Servers	C5-C8
*	Dell Computer Corporation	Notebook Computers	104-105
*	Dell Computer Corporation	Servers	203
*	Dell Computer Corporation	Dimension	214-215
*	Dell Computer Corporation	Servers	279
*	Dell Computer Corporation	Latitude & Dimension	311
*	Dell Computer Corporation	Notebooks, Dimension & Servers	54-55
*	Dell Computer Corporation	Notebook Computers	90-91
295	J&R Computer World	Systems, Hardware, Peripherals, Electronics	312-313
003	Micro Warehouse	Hardware, Software, Systems	316-317
119	Micron Electronics	Micron Family of Products	235-238
164	Micron Electronics	Micron Family of Products	36A-36N
013	Micron Electronics	Computer Now	5
153	NEC CSD	NEC NOW	114-115
154	NEC CSD	NEC NOW	220-221
155	NEC CSD	NEC NOW	80-81
156	NEC CSD	NEC NOW	82-83
047	PC Connection	PCs, Peripherals, Software	308-309
330	PC Mall	Hardware, Software, Peripherals	318-319
068	PC Zone	Mail Order	322-323
173	Premio Computers	Desktop	34
287	ProGen	Desktops and Notebooks	98-99
074	Quantex	Quantex Systems	131-133
309	S.A.G./Storage Solutions	Servers and Storage	38-39
*	Silicon Graphics	Workstation	43
*	Sony Computer Products	Notebook Computers	70-71
066	TigerDirect	233 MHz System	377
377	Toshiba	Notebook Computers	26-27
242	UMAX Technology	Mac System	165
241	UMAX Technology	Mac System	167
085	Winbook	Winbook 233 MHz Tillamook	77
	DATA BASE MANAGERS		
348	Computer Associates	Innoculan	270
*	Oracle Corp	Oracle 8	11
	DESK TOP PUBLISHING		
383	Puma Technology Inc	Intellisync	296
	DISK BACKUP & TAPE DRIVES		
227	Quarterdeck Corporation	DiskClone	292C
*	Digital Equipment Corp	Storage Works	110
211	Executive Software	Diskeeper	282
*	Imation	LS 120 SuperDisk	60-61
*	Iomega Corporation	Jaz	136-137
*	Iomega Corporation	Jaz	15
027	Micro Solutions Computer Products	Backpack Bantam CD-ROM	310
151	Philips Electronics	Philips OMNI/12	160
	DISPLAY PANELS/PROJECTORS		
108	Akia	LCD System	193
390	In Focus Systems	LCD Projectors	96
132	Proxima	Projector	283
	ENTERTAINMENT SOFTWARE		
*	Lucas Art Entertainment	Jedi Knight	364-365
	FAX SOFTWARE		
134	01 Communique Laboratory Inc	Communicate! Pro	263
	GRAPHICS SOFTWARE		
243	Viagrafix	Design CAD97	289
	HAND-HELD PC'S		
383	Puma Technology Inc.	Intellisync	296
	HARD DRIVES		
*	Iomega Corporation	Jaz	136-137
*	Iomega Corporation	Jaz	15
106	Kingston Technology Corporation	Memory	84
019	L.A. Trade	Memory, Hard Drives, PCMCIA	321
178	PowerQuest Corp	Drive Copy	209
315	Syquest Technology	Syquest Sparq	174
	HARDWARE		
*	3 Com Corporation	Cyclone	248
*	3 Com Corporation	SuperStack	256
235	AMS Tech	Rodeo Notebooks	41
030	A.T. Cross Company	I Pen	78
087	Acer America	TravelMate	177
*	Adaptec	Adaptec SCSI	57
*	CTX International	Notebooks	230
029	Canon Computer Systems	BJC-7004 Printer	22-23
*	CompUSA PC	CompUSA PC	198-199
203	Crucial Technology	Micron Memory Upgrades	67
*	Dell Computer Corporation	Notebooks, Dimension & Servers	C5-C8
*	Dell Computer Corporation	Notebook Computers	104-105
*	Dell Computer Corporation	Servers	203
*	Dell Computer Corporation	Dimension	214-215
*	Dell Computer Corporation	Servers	279
*	Dell Computer Corporation	Latitude & Dimension	311
*	Dell Computer Corporation	Notebooks, Dimension & Servers	54-55
*	Dell Computer Corporation	Notebook Computers	90-91
*	Diamond Multimedia Systems	56K Modem	156
152	Fluke Corporation	One Touch	259
*	Hewlett Packard	HP Sure Store CD-Writer Plus	92
184	iiyama Direct	Monitors	44
084	iiyama North America	Monitors	86
*	Imation	LS 120 SuperDisk	60-61
278	Insight	Insight Mail Order	204
*	Intel Corporation	Switch	25
*	Iomega Corporation	Jaz	136-137
*	Iomega Corporation	Jaz	15
295	J&R Computer World	Systems, Hardware, Peripherals, Electronics	312-313
039	MAG InnoVision	Monitors	18-19
003	Micro Warehouse	Hardware, Software, Systems	316-317
119	Micron Electronics	Micron Family of Products	235-238
164	Micron Electronics	Micron Family of Products	36A-36N
*	Mita Copystar	Mita DP Laser Printer	20
*	Mitsubishi Electronics	Monitors	179
048	Nvidia	3D Graphic Cards	50-51
330	PC Mall	Hardware, Software, Peripherals	318-319
080	PC Power & Cooling Systems	Power Protection/Cooling Devices	94
068	PC Zone	Mail Order	322-323
239	Plextor	CD-ROM Drive	297
173	Premio Computers	Desktop	34
287	ProGen	Desktops and Notebooks	98-99
024	QMS	QMS Magicolor 2	264
*	REAL 3D	3D Graphics Boards	368-369
309	S.A.G./Storage Solutions	Servers and Storage	38-39
*	Silicon Graphics	Workstation	43
*	Sony Computer Products	Notebook Computers	70-71
315	Syquest Technology	Syquest Sparq	174
*	Tektronix Inc.	Graphic Printing and Imaging	225
066	TigerDirect	233 MHz System	377
377	Toshiba	Notebook Computers	26-27
117	ViewSonic	GS 771 Monitor	64-65
118	ViewSonic	PJ 820 Projector	88
	HUBS		
*	3 Com Corporation	SuperStack	256
062	Amertek	Amertek	252
*	Intel Corporation	Switch	25
	INTERNET		
229	Quarterdeck Corporation	ViruSweep	292A
228	Quarterdeck Corporation	CleanSweep	292B
227	Quarterdeck Corporation	DiskClone	292C
134	01 Communique Laboratory Inc	Communicate! Pro	263
129	COMPUTER DISCOUNT WAREHOUSE	Networking Products	254-256
240	ESRI	Mapping Software	274
058	Ipswitch	WS FTP Pro	250
*	NetObjects	Fusion 2.0	273
*	Quarterdeck Corporation	RealHelp	292
*	Whistle Communications	InterJet	253
	LABEL/FORM SOFTWARE		
177	Cardiff Software	Teleforms	287
	LAPTOP/PORTABLE COMPUTERS		
087	Acer America	TravelMate	177
235	AMS Tech	Rodeo Notebooks	41
*	CTX International	Notebooks	230
*	CompUSA Direct	Mail Order	324-326

Infolink No	Company	Product	Page
360	COMPUTER DISCOUNT WAREHOUSE	Laptops	189
159	COMPUTER DISCOUNT WAREHOUSE	Laptops	190-191
109	COMPUTER DISCOUNT WAREHOUSE	Laptops	328-329
133	COMPUTER DISCOUNT WAREHOUSE	Laptops	330-331
•	Dell Computer Corporation	Notebooks, Dimension & Servers	C5-C8
•	Dell Computer Corporation	Notebook Computers	104-105
•	Dell Computer Corporation	Latitude & Dimension	311
•	Dell Computer Corporation	Notebook Computers	90-91
104	Gateway 2000	Notebooks, PCs, Mail Order, Peripherals	121-127
099	Gateway 2000	Notebooks, PCs, Mail Order, Peripherals	48A-49
295	J&R Computer World	Systems, Hardware, Peripherals, Electronics	312-313
003	Micro Warehouse	Hardware, Software, Systems	316-317
013	Micron Electronics	Computer Now	5
153	NEC CSD	NEC NOW	114-115
154	NEC CSD	NEC NOW	220-221
155	NEC CSD	NEC NOW	80-81
156	NEC CSD	NEC NOW	82-83
330	PC Mall	Hardware, Software, Peripherals	318-319
068	PC Zone	Mail Order	322-323
287	ProGen	Desktops and Notebooks	98-99
•	Sony Computer Products	Notebook Computers	70-71
377	Toshiba	Notebook Computers	26-27
085	Winbook	Winbook 233 MHz Tillamook	77

LOCAL AREA NETWORKING

•	3 Com Corporation	Cyclone	248
•	3 Com Corporation	SuperStack	256
348	Computer Associates	Innoculan	270
360	COMPUTER DISCOUNT WAREHOUSE	Networking Products	189
159	COMPUTER DISCOUNT WAREHOUSE	Networking Products	190-191
109	COMPUTER DISCOUNT WAREHOUSE	Networking Products	328-329
133	COMPUTER DISCOUNT WAREHOUSE	Networking Products	330-331
152	Fluke Corporation	One Touch	259
•	Intel Corporation	Switch	25
051	Data Comm Warehouse	Networking Products	261
024	QMS	QMS Magicolor 2	264
374	Seagate Software NSMG	Seagate Software-NSMG	243
•	Silicon Graphics	Workstation	43
•	Whistle Communications	InterJet	253

MAIL ORDER

108	Aka	LCD System	193
•	Arlington Computer Products	Mail Order, Peripherals	302
•	CompUSA PC	CompUSA PC	198-199
•	CompUSA Direct	Mail Order	324-326
360	COMPUTER DISCOUNT WAREHOUSE	Reseller	189
159	COMPUTER DISCOUNT WAREHOUSE	Reseller	190-191
109	COMPUTER DISCOUNT WAREHOUSE	Reseller	328-329
133	COMPUTER DISCOUNT WAREHOUSE	Reseller	330-331
104	Gateway 2000	Notebooks, PCs, Mail Order, Peripherals	121-127
099	Gateway 2000	Notebooks, PCs, Mail Order, Peripherals	48A-49
278	Insight	Insight Mail Order	204
295	J&R Computer World	Systems, Hardware, Peripherals, Electronics	312-313
019	L.A. Trade	Memory, Hard Drives, PCMCIA	321
051	Data Comm Warehouse	Networking Products	261
047	PC Connection	PCs, Peripherals, Software	308-309
330	PC Mall	Hardware, Software, Peripherals	318-319
068	PC Zone	Mail Order	322-323
074	Quantex	Quantex Systems	131-133
066	TigerDirect	233 MHz System	377
085	Winbook	Winbook 233 MHz Tillamook	77

MAPPING SOFTWARE

240	ESRI	Mapping Software	274

MASS STORAGE

•	Hewlett Packard	HP Sure Store CD-Writer Plus	92
•	Iomega Corporation	Jaz	136-137
•	Iomega Corporation	Jaz	15
027	Micro Solutions Computer Products	Backpack Bantam CD-ROM	310

MEMORY

203	Crucial Technology	Micron Memory Upgrades	67
106	Kingston Technology Corporation	Memory	84
019	L.A. Trade	Memory, Hard Drives, PCMCIA	321

MISCELLANEOUS

•	Avery Dennison	Labels and Stationary	288
•	Pitney Bowes	Personal Post Office	290

MODEMS

•	Arlington Computer Products	Mail Order, Peripherals	302
129	COMPUTER DISCOUNT WAREHOUSE	Networking Products	254-255
•	Diamond Multimedia Systems	56K Modem	156
153	NEC CSD	NEC NOW	114-115
154	NEC CSD	NEC NOW	220-221
155	NEC CSD	NEC NOW	80-81
156	NEC CSD	NEC NOW	82-83

MONITORS

108	Aka	LCD System	193
•	CompUSA PC	CompUSA PC	198-199
140	Hitachi	Monitors	286
184	Iiyama Direct	Monitors	44
084	Iiyama North America	Monitors	86
039	MAG InnoVision	Monitors	18-19
•	Mitsubishi Electronics	Monitors	179
153	NEC CSD	NEC NOW	114-115
154	NEC CSD	NEC NOW	220-221
155	NEC CSD	NEC NOW	80-81
156	NEC CSD	NEC NOW	82-83
157	NEC Technologies	A&E Monitors	C2-C4, p1
117	ViewSonic	GS 771 Monitor	64-65

MULTIMEDIA HARDWARE

113	ArcSoft	ZipShot	360
•	CompUSA Direct	Mail Order	324-326
027	Micro Solutions Computer Products	Backpack Bantam CD-ROM	310
239	Plextor	CD-ROM Drive	297

NETWORK INTERFACE CARDS

•	3 Com Corporation	Cyclone	248
129	COMPUTER DISCOUNT WAREHOUSE	Networking Products	254-255

NETWORK SYSTEMS/EQUIPMENT

373	Advanced Modular Solutions	Modular Ax	266
129	COMPUTER DISCOUNT WAREHOUSE	Networking Products	254-255
•	Dell Computer Corporation	Servers	203
•	Dell Computer Corporation	Servers	279
152	Fluke Corporation	One Touch	259
051	Data Comm Warehouse	Networking Products	261

NETWORKING SOFTWARE

228	Quarterdeck Corporation	CleanSweep	292B
229	Quarterdeck Corporation	ViruSweep	292A
227	Quarterdeck Corporation	DiskClone	292C
191	Meridian Data	CD Networking	246-247
299	Network Associates	Software	155
230	Quarterdeck Corporation	RealHelp	292

ON LINE SERVICES

•	AT&T WorldNet	WorldNet	293-295
056	Barnes & Noble	Books	32-33
•	ZD Net	NetBuyer	226

OPERATING SYSTEMS

187	Microsoft	Microsoft Windows	108-109
397	Microsoft	Platform	2-3

PC ACCESSORIES

030	A.T. Cross Company	I Pen	78

PC DIRECT

•	CompUSA PC	CompUSA PC	198-199
•	CompUSA Direct	Mail Order	324-326
360	COMPUTER DISCOUNT WAREHOUSE	Reseller	189
159	COMPUTER DISCOUNT WAREHOUSE	Reseller	190-191
109	COMPUTER DISCOUNT WAREHOUSE	Reseller	328-329
133	COMPUTER DISCOUNT WAREHOUSE	Reseller	330-331
•	Dell Computer Corporation	Latitude & Dimension	311
295	J & R Computer World	Systems, Hardware, Peripherals, Electronics	312-313
019	L.A. Trade	Memory, Hard Drives, PCMCIA	321
027	Micro Solutions Computer Products	Backpack Bantam CD-ROM	310
003	Micro Warehouse	Hardware, Software, Systems	316-317
047	PC Connection	PCs, Peripherals, Software	308-309
330	PC Mall	Hardware, Software, Peripherals	318-319
068	PC Zones	Mail Order	322-323
•	SPSS	SPSS 8.0 for Windows	332

PCMCIA

019	L.A. Trade	Memory, Hard Drives, PCMCIA	321

PERIPHERALS

030	A.T. Cross Company	I Pen	78
•	Diamond Multimedia Systems	56K Modem	156
004	Epson America	Epson Printer	12-13
104	Gateway 2000	Notebooks, PCs, Mail Order, Peripherals	121-127
099	Gateway 2000	Notebooks, PCs, Mail Order, Peripherals	48A-49
•	Imation	LS 120 SuperDisk	60-61
•	Intel Corporation	Switch	25
295	J&R Computer World	Systems, Hardware, Peripherals, Electronics	312-313
•	Mita Copystar	Mita DP Laser Printer	20
047	PC Connection	PCs, Peripherals, Software	308-309
330	PC Mall	Hardware, Software, Peripherals	318-319
151	Philips Electronics	Philips OMNI/12	160
024	QMS	QMS Magicolor 2	264
247	STB, Inc.	Accelerator Boards	8
•	Tektronix Inc.	Graphic Printing and Imaging	225
118	ViewSonic	PJ 1000 Projector	88

POWER PROTECTION

162	American Power Conversion	Symmetra	267-269
342	American Power Conversion	Surge Arrest/Station	31
080	PC Power & Cooling Systems	Power Protection/Cooling Devices	94

PRINTER ACCESSORIES

•	Avery Dennison	Labels and Stationary	288
•	Hewlett Packard	InkJet Printer Cartridges	138-150
024	QMS	QMS 2060	264
127	Ringdale	Print Server	260

PRINTERS

029	Canon Computer Systems	BJC-7004 Printer	22-23
•	Canon, U.S.A.	Canon USA - Graphic Systems	118-119
004	Epson America	Epson Printer	12-13
•	Mita Copystar	Mita DP Laser Printer	20
024	QMS	QMS Magicolor 2	264
•	Tektronix Inc.	Graphic Printing and Imaging	225

PROGRAM DEVELOPERS

393	Microsoft	IPT Internet Platform	58-59

Infolink No.	Company	Product	Page
	PROGRAMMERS TOOLS UTILITIES		
176	PowerQuest Corp	Drive Copy	209
	PROJECT MANAGEMENT SOFTWARE		
148	Primavera	SureTrak Project Management Software	72
	REMOTE COMPUTING		
•	Diamond Multimedia Systems	56K Modem	156
058	Ipswitch	WS FTP Pro	250
226	Quarterdeck Corporation	CleanSweep	292B
227	Quarterdeck Corporation	DistClone	292C
229	Quarterdeck Corporation	VirusSweep	292A
230	Quarterdeck Corporation	RealHelp	292
315	Syquest Technology	Syquest Sparq	174
	SERVERS		
•	Compaq Computer Corporation	Compaq Computer Corporation	74-75
129	COMPUTER DISCOUNT WAREHOUSE	Networking Products	254-255
•	Dell Computer Corporation	Servers	[illegible]
•	Dell Computer Corporation	Dimension	214-215
•	Dell Computer Corporation	Servers	279
•	Dell Computer Corporation	Notebooks, Dimension & Servers	54-55
240	ESRI	Mapping Software	274
086	Micron Electronics	NetFrame	16-17
153	NEC CSD	NEC NOW	114-115
154	NEC CSD	NEC NOW	220-221
155	NEC CSD	NEC NOW	80-81
156	NEC CSD	NEC NOW	82-83
•	Oracle Corp	Oracle 8	11
127	Ringdale	Print Server	260
309	S A G /Storage Solutions	Servers and Storage	38-39
•	Whistle Communications	InterJet	253
	SOFTWARE		
134	01 Communique Laboratory Inc	Communicate! Pro	263
139	DPS Inc	Video Editing Software	291
240	ESRI	Mapping Software	274
191	Meridian Data	CD Networking	246-247
003	Micro Warehouse	Hardware, Software, Systems	316-317
187	Microsoft	Microsoft Windows	108-109
•	NetObjects	Fusion 2.0	273
298	Network Associates	Software	155
208	Panda Software	24h-365d Antivirus Insurance	265
047	PC Connection	PCs, Peripherals, Software	308-309
330	PC Mall	Hardware, Software, Peripherals	318-319
176	PowerQuest Corp	Drive Copy	209
148	Primavera	SureTrak Project Management Software	72
363	Puma Technology Inc	Intellisync	296
•	SPSS, Inc	SPSS 8.0 for Windows	332
335	Sun Microsystem	Sun Microsystem's Software	69
	STATISTICAL SOFTWARE		
•	SPSS, Inc.	SPSS 8.0 for Windows	[illegible]
	TELECOMMUNICATIONS		
•	Diamond Multimedia Systems	56K Modem	156
	TRAINING/SEMINARS/CONFERENCES		
352	ZD Comdex & Forums	Networld + Interop Las Vegas '98	367
237	Miller Freeman	Network Expo Show	227
	UTILITIES		
298	Network Associates	Software	155
176	PowerQuest Corp.	Drive Copy	209
	VIDEO GRAPHICS/BOARDS		
380	Matrox Graphics Inc.	Productiva G100	100
046	Nvidia	3D Graphic Cards	50-51
	WEB/INTERNET SERVICES		
•	Whistle Communications	InterJet	253
177	Cardiff Software	Teleforms	287
348	Computer Associates	Innoculan	270
058	Ipswitch	WS FTP Pro	250
•	SPSS, Inc	SPSS 8.0 for Windows	332
	WIRELESS NETWORK EQUIPMENT		
337	RadioLAN	Wireless Networking	251
	WORKSTATIONS		
•	Silicon Graphics	Workstation	43

For Additional Categories see MARKETPLACE PRODUCT INDEX PAGE 333.

Coming Up

What's in the Next Issue of *PC Magazine*

Fast PCs

The progress of PC technology isn't defined by Moore's Law alone. Processing power does indeed double every 18 months, but the hardware surrounding the processor is improving almost as fast. We test and review new systems equipped with the very latest in Pentium II processor technology and P6 chip set design—machines targeted at professional/enthusiast PC users.

Network Laser Printers

Like PCs and most PC peripherals, laser printers continue the trend of "better, faster, cheaper." The latest generation deliver advances in networking and administration that make laser printers easier to set up and configure on a network, even if you're not an MIS professional. And robust paper-handling options such as collating, sorting, and stapling mean end users won't have to visit the copier as often. PC Labs tests 18 monochrome and 10 color printers for your workgroup.

Faster Connections

Looking for a way to share that ISDN line between a couple of PCs? It may be time to move to a router. Yes, a router—don't be afraid of the word. Several of these low-end devices (from big names) are remarkably easy to get running—and keep running. We review a dozen "personal routers" that cost well under $1,000 and can make the most of your ISDN and LAN investment.

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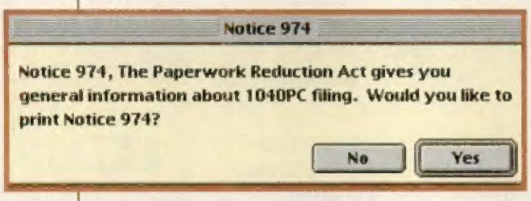

A little tax-time humor courtesy of Intuit's Macintax.

Are Your Kids Ready for College?

Here's a practice grammar-test question included in Barron's PSAT preparation book (9th edition, 1997).

"Anyone interested in the use of computers can learn much if you have access to a Radio Shack TRS-80 or a Pet Microcomputer.

A: if you have access to
B: if he or she has access to
C: if access is available to
D: by access to
E: from access to"

Put that cup holder to good use! (*AutoWeek*.)

Classified Intelligence

"Trade 20-gallon fish tank with accessory stand and 55-gallon tank with 3 large Piranha for Pentium computer."
—*Anchorage Daily News*

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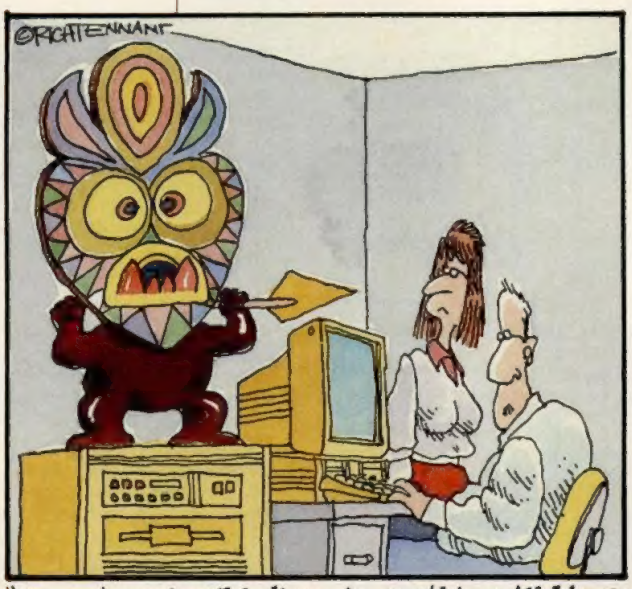
Maybe we should be comforted by the fact that the Internal Revenue Service takes absolutely nothing for granted.



"I'm not saying I believe in anything. All I know is since it's been there our server is running 50% faster."

Ten Years Ago in *PC Magazine*

"The real beneficiary of Lotus 1-2-3 Release 3 will probably turn out to be OS/2. Since Lotus will ship a DOS and OS/2 version in the same box, hundreds of thousands of people will suddenly have a reason to run OS/2, if for no other reason than to keep 1-2-3 always a key combination away."—May 17, 1988

This *PC Week* photo of a data-mining expert is cute, but there's one problem: He's holding a mountaineer's ice pick, not a miner's pick.

If your entry is used, we'll send you $50 and a *PC Magazine* T-shirt. Send your entries to Abort, Retry, Fail?, *PC Magazine*, One Park Ave., New York, NY 10016-5802. Winners this issue: Dana Cline, Randal Fernandez, Jim Green, Moses Fridman, Andy Peng, and Ken Stevenson.

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